

THE EUROPEAN UNIVERSITY INSTITUTE

Department of Economics

**A Dynamic Model of Married Women's Labour Supply
with an Application to Great Britain and Germany**

Tindara ADDABBO

Thesis submitted for assessment with
a view to obtaining the Degree of Doctor
of the European University Institute.

Florence, November 1992

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with an Application to Great Britain and Germany**

Tindara ADDABBO

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INTRODUCTION

In recent decades married women's labour supply has been the most dynamic component in the labour market of many industrialized countries. In this thesis, we will focus on the analysis of married women's labour supply in the U.K. and in West Germany. In both countries married women's labour market participation increased sharply. In the U.K. the activity rates for married women aged from 16 to 60 passed from 42.3% in 1971 to 49.9% in 1986, in West Germany the activity rates for the same group of women increased from 35.6% in 1970 to 42.5% in 1985. As we will show more in depth in Chapter 5 the difference in the level of married women's participation in the two countries is to be imputed to several factors. Amongst them:

- higher diffusion of part-time work in the U.K. than in West Germany. This type of job is highly spread amongst women in childrearing years who found it to be more compatible with childrearing and other household's activities.
- higher importance of the Service Sector in the U.K. than in West Germany. Generally the Service sector has been found to employ a large portion of women.
- different tax system. The split type of taxation, that is largely adopted in West Germany, has been found to discourage married women's labour supply. According to the split system of taxation (not to be found in the U.K.) the tax liability is computed by dividing the total income of the family (after the appropriate deductions) by two and by applying the progressive tax schedule to each half.

Apart from the increase in the level of labour market participation of married women outlined above, one should notice that also married

women's work-profile has been changing in most industrialized countries, and it is on this type of change that we will concentrate. In countries like Sweden women's work profile is becoming increasingly similar to that of men, while in countries like the ones investigated in this Thesis (U.K. and West Germany) female work-profile is still of an M-shaped type (with exit in childbearing and rearing years). However also in the U.K. and in West Germany, amongst younger cohorts a tendency towards quicker return in the labour market or no withdrawal at all from it during childrearing years has been witnessed by means of longitudinal analyses.¹

This life cycle change in the behaviour of married women's labour supply has important implications also on the theoretical models on wage differentials by gender.² Moreover one can notice how the actual number of women "staying in the labour market" is higher than the number predicted by standard labour supply models,³ and how static models of labour supply cannot explain the life cycle behaviour of labour supply.

Given the type of changes which have occurred in female labour supply we will devote our attention to dynamic models. The thesis is divided in two parts. In Part 1 we survey the literature on dynamic models of labour supply and we elaborate a model which relaxes the intertemporal separability assumption of the lifetime budget constraint through the "wage-experience" relationship. Part 2 is concerned with the application of the model presented in Part 1 to British and German data.

¹ Refer to Chapter 5 in the Second Part for a descriptive analysis of female labour supply over the life cycle by marital status in West Germany and in the U.K. and to Mincer (1985) for a survey on married women's participation across countries.

² For instance Mincer and Polachek's (1974) theory of wage differentials by gender based on the existence of a broken work-profile for women loses ground in a situation like the Swedish one where women show an inverted U work-profile typical of men and there is still wage discrimination by gender.

³ Refer to Nakamura and Nakamura (1985b).

The theoretical framework of the standard dynamic model of labour supply which assumes intertemporal separability of the lifetime utility function and of the lifetime budget constraint is outlined in Ch.2 (Section 2.1), where we analyse also the implications of these assumptions. The early models on life cycle labour supply surveyed in Section 2.2 have in common the type of data set used for empirical analysis: synthetic cohort data. We discuss the approach followed to construct them and their disadvantages in Section 2.2. These disadvantages can be avoided by using other types of data (like panel or pseudo panel data) as the models on life cycle labour supply surveyed in Section 2.3 (which follow more closely the approach outlined in Section 2.1) do.

The implications of the assumptions of intertemporal separability of the lifetime utility function and of the lifetime budget constraint have been largely questioned by the evidence surveyed in Chapter 3 (Section 3.1.1). We survey the models which relax the intertemporal separability assumption of the lifetime utility function in Section 3.1.2, which provides also a description of factors which can lead to its rejection. Models which relax the assumption of intertemporal separability of the lifetime budget constraint by introducing wage endogeneity are surveyed in Section 3.1.3.

Chapter 3 contains also a survey of the models which consider the effect of fixed costs of working on female labour supply in a static (3.2.1) and in the standard dynamic setting (3.2.2), and a discussion on the implications of the survey of models carried out in Chapters 2 and 3 for our research (Section 3.3).

The wage-experience model that we present in Chapter 4 relaxes the assumption of intertemporal separability of the lifetime budget constraint by introducing past work experience in the wage equation.

The first issue that we include in the model and that we try to test by using British and German data in the Second Part of the thesis, is the existence of experience effects on wages. This effect may arise because of human capital accumulation or because of seniority reasons and indeed in our empirical analysis we find evidence for the existence of the wage-experience effect. Having shown the existence of a positive effect of past work experience on current wages we turn to analyse how women take into account this relationship in their decision on labour supply.

In the standard dynamic labour supply model surveyed in Chapter 2 the expected increase in wages will bring about a reduction in current hours of work via intertemporal substitution. In our wage-experience model, on the other hand, the total effect of an increase in forward wages is uncertain because it is made up of the usual negative substitution effect (which produces a decrease in current hours of work) and of the positive experience effect (according to the latter, higher forward wages are related to higher current hours of work).⁴ We also analyse the effect of the introduction in our dynamic wage-experience model of labour supply of fixed money costs of working related to the presence of young children in the family (Section 4.2) and we compare our model to other life cycle models on labour supply (Section 4.3).

The Second Part of the thesis is devoted to empirical analyses including the estimation of the model presented in Chapter 4 on U.K. and German data. The two countries which are the object of our empirical analysis have different institutional constraints on female labour supply behaviour, as Chapter 5 shows. They also differ in the level of married women's participation in paid work and in the diffusion of part-time and service work amongst married women, though in both countries married women's

⁴ The wage-experience effect can also be found in Chapter 7 where we analyse wage and earnings mobility by gender by using German panel data.

participation in paid work and in the diffusion of part-time and service work amongst married women, though in both countries married women's labour supply has been increasing in the last decade. In Chapter 5 we survey the empirical analyses on married women's labour supply in Great Britain and Germany with particular attention to the few dynamic applications.

As we show in Chapter 4, the existence of the wage-experience relationship brings into the employment equation forward terms in wages and in employment. In order to estimate our theoretical model it is therefore necessary to obtain longitudinal data. However, longitudinal data with the information we need in order to estimate the model, are not available in most of the European countries.

In Chapter 6, we compare two types of data set useful for the estimation of life cycle models: genuine panel data (which follow the same individual over time) and pseudo panel data (which follow the same cohort over a time series of random cross sections) and we describe the data set that we use for the estimation of our dynamic model to Germany and Great Britain. In Chapter 6 we present a technique that one could follow in order to estimate a dynamic model on labour supply when panel data are not available. We apply this approach to construct proxies for forward and lagged independent variables. The data set that we build for the U.K. allows us to estimate the Structural form of the dynamic model presented in Chapter 4 and to recover estimates of the Structural parameters of our model (the results of this estimation can be found in Chapter 8). For Germany, the other subject of our empirical analysis on married women's labour supply, an individual households' panel data is available and we describe it in Section 6.2.3. Chapter 6 contains also some descriptive

statistics on the samples drawn for the estimation of our model from U.K. (Section 6.3.1) and German (Section 6.3.2) data.

The assumption that past work experience has a significant effect on the current level of wages has also an implication for wages mobility, namely we expect wages mobility to differ across people characterized by a discontinuous work-profile and people continuously at work, because of seniority or because of human capital accumulation. The availability of individual panel data allows us to analyse earnings and wages mobility from 1984 to 1987 by gender in Germany. The use of different measures to analyse mobility (transition matrices, correlation and regression coefficients) is described in Ch.7. Our analysis of women's wages and earnings mobility adds new information on a topic that, as Atkinson, Bourguignon and Morrisson (1991) stress, has been rarely investigated by using German data. We can also compare our results on German workers with the analyses on earnings mobility by cohort and on earnings mobility by time intervals available.

We then turn to the estimation of our dynamic wage-experience model on married women's labour supply by using British and German data.

In order to estimate the model on the British data set described in Chapter 6, we have followed a 5 step procedure. In the first step we estimate a Probit model on the employment probability of married women in the sample (Section 8.1.1). In the Second step we estimate a log wage equation corrected for selection bias, where past work-experience enters amongst the other right hand side variables (Section 8.1.2). The third step is devoted to the estimation of the log of Consumption equation (Section 8.1.3) in order to predict consumption to

substitute away marginal utility of net worth. In the fourth step we carry out a 2 Stage least squares estimation of a log linear approximation of the structural form demand for leisure equation, with the logarithms of predicted consumption and of predicted net wages amongst the independent variables. In this step we also test for the significance of the predicted against the actual measures of wages and consumption. In the final step we estimate the structural form model for the demand of leisure which allows us to recover structural parameters estimates and estimate of the intertemporal substitution elasticity. The results of the estimation at each stage are referred to in Chapter 8, where we compare the estimates of the structural parameters with the ones obtained by other models.

The data available for West Germany, as we have discussed above, have the advantage of being an individual household's panel data. However, they do not provide information on individual household's consumption; we are therefore forced to estimate a quasi-reduced form of our dynamic wage-experience model on married women's labour supply in Chapter 9 . The estimation in this case is carried out in 3 steps:

- 1) Estimation of a Probit model on the employment probability of married women in the sample;
- 2) estimation of a log wage equation which takes into account the work-experience effect and its interaction with education and it is corrected for selection bias. We compare the results obtained from the estimation of the wage-experience equation with individual household's panel data on past work experience with the wage equation estimated by using cohort constructed proxies for past work experience by using the German Panel data, and by following the procedure described in Chapter 6, in order to see whether the size and significance of the coefficient of past

work experience computed by using individual panel data or cohort proxies differ.

3) estimation of a quasi-reduced form for the employment probability of German married women in 1987, where forward terms in wages and in employment status enter amongst the right hand side variables.

In Section 9.2 we conclude by estimating a bivariate model of married women's employment probability and of the probability of working in a full-time position. We test for the significance of the correlation coefficient between the disturbances of the two models.

The individual employment equations that we estimate in Chapter 8 and in Chapter 9 contain also individual and households' variables which generally enter standard labour supply model. It is therefore interesting to compare the results obtained by estimating our model to other dynamic models which do not consider the wage-experience effect.

A summary on the results obtained in the different parts of the thesis outlined above, together with some concluding remarks are to be found in Chapter 10.

PART I

A DYNAMIC MODEL OF MARRIED WOMEN'S LABOUR SUPPLY:
RELAXING THE INTERTEMPORAL SEPARABILITY ASSUMPTION
OF THE LIFETIME BUDGET CONSTRAINT

CHAPTER 2

EARLY DYNAMIC MODELS OF LABOUR SUPPLY WITH SEPARABLE PREFERENCES AND LIFETIME BUDGET CONSTRAINT

Introduction

Ch. 1 has outlined the major changes which have occurred in female labour supply. We have stressed the importance, in order to explain these changes of analysing labour supply in a dynamic setting.

In the following Section we will outline the basic theoretical framework followed to analyse labour supply in a dynamic setting, and we will stress its main assumptions and implications. We discuss how the theoretical model described leads to estimable demand functions and we show the consequences of the assumptions that the model maintains on the lifetime utility function and on the lifetime budget constraint.

Early models on life cycle labour supply are surveyed in Section 2.2, where we discuss also the restrictions that they apply to the general framework described in Section 2.1. These models have in common the approach followed to build the data set used for empirical analysis: the so called "synthetic cohort approach". We will describe this method and highlight its disadvantages in Section 2.2, while a discussion on the alternative data set that can be used for the estimation of life cycle models is to be found in Chapter 6 where the data issue is addressed more in depth.

The models surveyed in Section 2.3 follow more closely the theoretical framework described in Section 2.1. We present their main empirical results and discuss their method of estimation.

Some concluding remarks on the evidence provided in this Chapter can be found in Section 2.4.

Section 2.1 - Frisch demands models of labour supply:

Theoretical framework

The theoretical structure of the models surveyed in this Chapter can be obtained by extending the static neoclassical model of labour supply to multiperiod choice.⁴

$$(1) U_t = U(C_t, L_t)$$

(1) is the instantaneous utility function whose arguments are consumption and leisure and which is assumed to be well behaved. The static model of choice between consumption (C) and leisure (L) is then extended to multiple period allocation of time by specifying the following lifetime utility function:

$$(2) V = [U_1(C_1, L_1), U_2(C_2, L_2), \dots, U_T(C_T, L_T)]$$

where T is death or retirement date.

The models surveyed in this Chapter assume additivity of the lifetime utility function. Therefore they assume a specific form for equation (2):

$$\sum_{t=0}^T (1+\rho)^{-t} U[C_t, L_t]$$

where ρ = individual rate of time preference

C_t = consumption at time t

L_t = leisure at time t

⁴ For detailed analyses on this extension refer to Killingsworth (1983), Deaton and Muellbauer (1986) and Killingsworth and Heckman (1986).

The above lifetime utility function is then maximized subject to a lifetime budget constraint (equation 4) where the discounted consumption equals discounted earnings plus nonlabour income. If one ignores bequests equation 4 will hold as an equality. Wages are assumed to be exogenous. The models surveyed in this Chapter assume intertemporal separability of the lifetime budget constraint.

$$(4) A_0 + \sum_{t=0}^T (1+r)^{-t} [W_t H_t - P_t C_t] \geq 0$$

where A_0 = initial assets

r = constant interest rate

W_t = wage level during period t

P_t = price level during period t

Equation (5) is the Lagrangean of the problem.

$$(5) L = \sum_{t=0}^T (1+\rho)^{-t} U[C, L] + \lambda_0 \left\{ A_0 + \sum_{t=0}^T (1+r)^{-t} [W_t H_t - P_t C_t] \right\}$$

Where the Lagrange multiplier λ_0 can be regarded as the marginal utility of initial assets, or as the imputed value of initial wealth A_0 . If λ_0 is low that means that the individual gives a low value to his initial wealth and so he will tend to spend more on leisure or on consumption than another individual with a higher λ_0 .

The First order conditions for the above maximization problem are the following:

$$5.1 \partial L / \partial C_t = (1+\rho)^{-t} U_C[\dots] - \lambda_0 (1+r)^{-t} P_t = 0$$

$$5.2 \partial L / \partial L_t = (1+\rho)^{-t} U_L[\dots] - \lambda_0 (1+r)^{-t} W_t \geq 0$$

$$5.3 \partial L / \partial \lambda_t = A_0 + \sum_{t=0}^T (1+r)^{-t} [W_t H_t - P_t C_t] = 0$$

Where $\lambda_t = [(1+r)/(1+\rho)]^{-t} \lambda_0 \Rightarrow \lambda_0 = [(1+r)/(1+\rho)]^t$. By substituting this in 5.1 and 5.2 and multiplying by $(1+\rho)^t$, one gets:

$$5.1' \quad \partial L / \partial C_t = U_C(\dots) - \lambda_t P_t = 0$$

$$5.2' \quad \partial L / \partial L'_t = U_L(\dots) - \lambda_t W'_t \geq 0 \text{ where } > 0 \Rightarrow H'_t = 0$$

By strict concavity of the instantaneous utility function it is possible to invert 5.1' and 5.2' to get the so called Frisch or marginal utility of wealth constant demand functions (6) and (7):²

$$(6) \quad C_t = C[\lambda_t P_t, \lambda_t W'_t]$$

$$(7) \quad L'_t = L[\lambda_t P_t, \lambda_t W'_t]$$

These demand functions are called λ constant because the marginal utility of wealth λ differs across individuals but for any given individual with perfect foresight is constant over the life cycle in this model.³ This implies an important advantage of this model for econometric application. In fact, given that λ is constant, it can be treated as an individual specific fixed effect, we will discuss the estimation issue more in depth in Section 2.3.

Equation (7) implies that labour supply decisions at any point in time are related to variables outside that period only through their effect on λ , the marginal utility of wealth, which, as MaCurdy (1981) stresses can be considered like the permanent income in the theory of the consumption function. At each period, the marginal utility of wealth is a sufficient statistic summarizing all past and future

² Browning (1982) was the first to refer to demand functions of this type as Frisch demands since Frisch (1932) used additive preferences to measure the marginal utility of money. For a deeper discussion on these demands and their properties in a dynamic labour supply model refer to Browning, Deaton and Irish (1985; pp.506-510) and to Blundell and Meghir (1990). On the life cycle models based on two-stage budgeting and for a comparison between the latter and the Frisch demand models, refer to Blundell (1987) and to Blundell and Walker (1986).

³ No aggregate shocks are included in the models surveyed in this Chapter.

information on wages and nonlabour income which are necessary for the individual to decide about his current allocation of time.

By using this type of model one can carry out simple dynamic equilibrium exercises or comparative dynamics. By means of the latter it can be shown that the effect of an increase in wages on labour supply can be decomposed in the Frisch effect (or marginal utility of wealth constant effect) which will be positive, and in the marginal utility of wealth variable, or indirect effect, which (as an increase in wage causes a decrease in λ) will be negative. While in comparative statics the level of utility was held constant or variable, in comparative dynamics one takes as constant or variable the marginal utility of initial assets and not their levels.

As noted above, the effect of life cycle (evolutionary) variation in wages holding constant the marginal utility of wealth is different from a shift in wages during all dates which changes both the marginal utility of wealth and wages. As Blundell (1987) stresses, the static specification of labour supply model based on a single cross section is unable to separate the effect of evolutionary changes in wages from the effect of parametric changes in wages. On the other hand these two effects can be separately analysed by dynamic model of labour supply.

One of the properties of the λ -constant demand functions specified above is that the wage elasticities of the labour supply function can identify the effect of fully anticipated evolutionary changes in wages.[†] The intertemporal substitution elasticity (γ) measures the hours of work response to evolutionary changes in wages and can be used to predict differences in individual's labour supply over time. In the following Sections we will survey the evidence provided on this parameter by empirical analyses.

[†] Refer to MaCurdy (1981) and to Killingsworth and Heckman (1986) for a formal derivation of effects of evolutionary and parametric changes in wages in Frisch demand models of labour supply.

The theoretical model outlined above makes two important assumptions concerning the intertemporal separability of the lifetime utility function and of the budget constraint.

The model assumes that preferences are additive over time. This strong assumption has the following advantages:

- 1) as stressed by Killingsworth (1983) it allows to treat the life cycle as a sequence of individual periods and to find the lifetime utility by simply adding up the utilities received in each period. Moreover, as Blundell (1987) shows, it allows direct application of the two-stage budgeting theory;
- 2) by assuming intertemporal separability of the lifetime utility function one can produce estimable structural form equations for leisure and easily recover estimates for the intertemporal substitution elasticity as we will discuss more in depth in Section 2.3. In fact this assumption makes possible to write demand functions in terms of the marginal utility of wealth which captures all unobservables and can be treated as an individual fixed effect and eliminated by means of first differencing by using panel data when it enters the demand equation in a linear way. Moreover, as we discuss below, this assumption produces firmer predictions on the effect of changes in wages on leisure time at different dates.

However, the assumption of intertemporal additive separability of the lifetime utility function produces some strong restrictions:

- 1) if leisure times in all periods of the life cycle are normal goods, additive separability of the utility function over time implies that leisure times at different dates must be substitutes.⁵ The signs of all the intertemporal cross-substitution effects are therefore constrained to be negative, when under nonseparability the signs of

⁵ For a formal proof of this implication refer to Deaton (1974) and to Deaton and Muellbauer (1986). The latter consider additivity in the intertemporal choice more acceptable than in the static case. Since one does not expect that strong substitutabilities and complementarities between periods occur.

these effects are unrestricted. This can be considered an advantage in terms of the firmer prediction that the model yields on the effect of changes in wages on leisure over time as stated above. In fact it implies that an increase in the wage rate at t will always increase leisure time in other periods (holding the marginal utility of wealth constant). However, this assumption rules out the possibility that leisure times in different periods can be complements. For instance, this rules out employment profiles where an increase in the current wage rate is conditional on the provision of the same amount of working hours in the following periods like it can happen if one sticks to a contract.

2) the assumption of additive separability of the lifetime utility function over time implies that the marginal rate of substitution at time t is a function only of consumption and leisure at time t , but not of consumption and leisure in other dates $t+j$ (where j differs from 0), and that it is equal to the current real wage. As Killingsworth (1983) shows, this implies that given an expression for the marginal rate of substitution at time t , one can easily derive expressions for consumption and leisure at time t in terms of the current real wage. The individual is able to adjust within one period his hours of work to temporary changes in real wages. Current demands depend only on current prices and on current marginal utility of wealth, which, under the assumption that no aggregate shocks occur, remains constant. However, this implies that hours of work supplied at time t are independent of past and forward hours of work and on past and forward wages. This rules out any persistence effect in the individual's labour supply behaviour over the life cycle (that makes current labour supply decisions dependent on past or forward hours of work). However, the analyses surveyed in the following Chapter provide evidence in favour of the existence of persistence effect in the individual's employment behaviour.

The Frisch demand model that we have presented in this Section assumes that the individual is able to adjust his hours of work over

his life cycle in response to changes in the wage rate. This implicitly regards unemployment to be a voluntary use of non-market time and implies that unemployed are on their intertemporal labour supply function. However, this implication has been rejected by the empirical evidence surveyed in Chapter 3.

Another stringent assumption of the Frisch demand models surveyed in this Chapter is the assumption of intertemporal separability of the lifetime budget constraint (equation 4). More precisely, equation 4 assumes intertemporally additive budgets. According to Equation 4 current saving decisions do not affect interest rates and future discounted prices. Moreover, equation 4 implies that current hours of work decisions have no effect on forward wages.

The assumption of intertemporal additivity of the budget constraints over time will be violated if one assumes imperfect capital markets or wage endogeneity. In fact, when one introduces imperfect capital markets in the model, current saving decisions will depend on interest rates and future discounted prices. The main theoretical consequence of the assumption of wage exogeneity is that it leads to the exclusion from the individual's demand for leisure of the expected present value of the marginal effect of current hours of work on future wages (we show this formally in Chapter 4 by presenting a model which relaxes the assumption of intertemporal separability of the budget constraint by introducing a wage-experience equation). This exclusion in turn rules out any persistence in employment caused by on the job human capital accumulation and, as Shaw (1989) stresses, this can lead to a systematic bias in the estimated elasticities.⁶

⁶ We will discuss this problem more in depth in Chapter 3.

Section 2.2 - Early dynamic models of labour supply and the Synthetic Cohort Approach

In this Section we will survey a group of models on life cycle labour supply whose theoretical framework can be expressed in terms of the Frisch demand model outlined in Section 2.1, and that use the same type of data set for the estimation. We refer to the models by Becker (1975) on the allocation of time by men over their lifetime (which applies the model of Ghez and Becker, 1975) and by Smith (1977) in his analysis on the family labour supply over the life cycle.

Ghez and Becker (1975) used a model based on the Fisherian theory of consumption over time and on the theory of the allocation of time in the new-home-economics tradition (with the family acting as a small firm with a constant return to scale household's production function). However, in the empirical specification of Ghez and Becker's (1975) model of the allocation of time, Becker (1975) limits his analysis to employed men.

On the other hand, Smith (1977) estimates a multi-earners model of labour supply explicitly accounting for the substitution of time between members over the life cycle in the household's production function. Differently from Ghez and Becker (1975), Smith (1977, p.207) introduces the different inputs of time of wife and husband separately into the instantaneous household's production function, together with market goods. By assuming away corner solutions, he gets equations of husband's and wife's time which are functions of the wage rates of both, of the rate of time preference, of changes in the technology of the household's production function over the life cycle, of the rate of intertemporal substitutability between inputs in the production of household commodities and in consumption.

In contrast with the static model of labour supply, the dynamic model of labour supply used by Smith, predicts that the effect of an increase in

women's wage rate on her hours of work will be unambiguously positive. This occurs because in the dynamic models of Ghez and Becker (1975) and of Smith (1977) the full wealth (i.e. the present value of the wealth that an individual would accumulate if he devotes all his available time to working and bank all his earnings in each period) is fixed. In analysing the effect of a change in wage on labour supply they consider only the marginal utility of initial assets constant effect, and they neglect the marginal utility of initial wealth variable effects, that we have described in the previous Section.

In Smith (1977) the positive effect of an increase in wife's wage rate on her market hours of work arises because of two positive effects:

1) By assuming that wife's and husband's inputs of time in the household's production are substitutes (i.e. $\sigma_{MF} > 0$) and that also wife's inputs of time and market goods are substitutes ($\sigma_{FX} > 0$) the household will substitute husband's inputs of time and market goods for wife's inputs of time in the production of commodities as the price of wife's inputs of time increases. This substitution effect will increase the wife's hours of work in the market;

2) since the price of one input in the household production function is rising, the relative price of commodities at time t will rise too. This will produce a general decline in commodities production at time t and this will reduce the demand of all inputs, including wife's home time leading to an increase in wife's market hours of work.

On the other hand the effect of an increase in the husband's wage on women's nonmarket time is ambiguous even without considering both marginal utility of wealth constant and marginal utility of wealth variable effects in the dynamic setting. In fact as the husband's wage increases:

1) at time t his inputs of time will be relatively more expensive than his wife's inputs of time in the household's production function and so given the assumption of perfect substitutability between the two inputs of time mentioned above ($\sigma_{MF} > 0$), the

household will substitute wife's inputs of time for husband's inputs of time in its production function so the substitution effect on women's market time of an increase in her husband's wage rate will be negative;

2) the increase of the husband's wage rate will bring about a rise in the price of commodities at time t . This, given the existence of a positive intertemporal elasticity of substitution for commodities ($\sigma_c > 0$), brings about a reduction in commodities production at time t and therefore all inputs in the household's production function will be reduced at time t . Amongst them also women's inputs of time, so this effect will bring about an increase in women's market time even if no marginal utility of wealth variable effect has been considered.

The net effect is going to depend then, as Smith (1977, p.210) stresses, on the relative size of the commodity and inputs elasticities of substitution. If the intertemporal elasticity of substitution for commodities (σ_c) is greater than the elasticity of substitution between the inputs of husband and wife's time in the household's production function (σ_{MF}) an increase in husband's wage rate will induce an increase in his wife's hours of work into the labour market rather than a decrease.

For wives of white, high school and college men in the sample selected by Smith (1977) in the estimation of his model, the effect of an increase in their husband's wages is negative on their market activities (so $\sigma_c < \sigma_{MF}$). Different results are obtained in the estimation of the model for the subsample of nonwhite married women, in general the results obtained are consistent with the prediction of the model.

As we have stressed in the Introduction to this Chapter, the analyses surveyed in this Section have in common also the method followed to recover a data set in order to estimate their models: the synthetic cohort approach. This method consists in using a

single cross-section data set to reconstruct the life cycle profile of the variables. One splits the sample by age and computes means for each variable of interest on the individuals in each age groups. Then one uses the means obtained in order to build a so called synthetic life cycle profile for wages, hours of work and other variables.

The synthetic cohort approach described above has the main disadvantage of confusing the cohort effects with the ageing effects. As Killingsworth (1983, p.284) stresses:

"Because such data refer to individuals observed at a given moment in time (e.g., the 1980 Census), differences in age in such data are necessarily differences in vintage as well: Someone 50 years old in 1980 comes from the 1930 (i.e., the Depression-era) "vintage", someone 20 years old in 1980 comes from the 1960 (i.e., Vietnam war-era) "vintage" and so on. Thus, in order to accept estimates of life cycle labour supply parameters derived from such data, one must be willing to assume, for example, that, if faced with the same initial wealth, wage profile, and so forth, a representative individual of the 1960 vintage would behave in exactly the same way in the year 2010 as a representative individual of the 1930 vintage behaved in 1980".

By following this approach, the labour supply equation to be estimated is:

$$(1) \quad \overline{\log h_t} = \beta_0 + \beta_1 \overline{\log w_t} + \beta_2 \overline{Z_t} + \beta_3 \overline{t} + \epsilon_t$$

h_t = hours of work

w_t = wages

Z_t = other observed factors affecting the labour supply decision

ϵ_t = unobserved factors affecting the labour supply decision.

t = each age (and birth year)

The bars indicate group means.

In the following table we summarize the results of estimation of intertemporal substitution elasticities for the models surveyed in this Section:

ESTIMATES OF INTERTEMPORAL SUBSTITUTION ELASTICITIES

(Standard error in brackets)

Male labour supply:	Non-White Men	White Men
Becker (1975) ¹	0.10 (0.04)	0.45 (0.10)
Smith (1977) ²	0.23 (0.11)	0.32 (0.05)

Female Labour supply:

	all women in sample	only working women
Smith (1977) ²	0.56 (0.15)	1.15 (0.23)

1. He uses a synthetic cohort approach built on the 1960 USA Census for the 1/1,000 sample for non agriculture employed men
2. Smith (1977) uses a synthetic cohort approach based on the USA 1967 Survey of Economic Opportunity.

All the coefficients above reported are significant at 95% level of confidence. In Smith's log hours equation the log wage of the partner together with the own wage is included amongst the explanatory variables.

As MaCurdy (1981) stresses, Ghez and Becker (1975) and Smith (1977) do not explicitly interpret their parameter estimates as being those of the marginal utility of wealth constant labour supply function. However, given the above log-linear specification $\log \lambda$ (logarithm of the marginal utility of initial wealth) is absorbed into the intercept term β_0 . If the latter has the same value for all ages (i.e. if there are no cohort effects) then group means, as Pencavel (1986) highlights, act as an instrument and Ordinary Least Squares applied to the above equation yield consistent estimates. In this case by estimating β_1 one gets an estimate of the intertemporal substitution elasticity.

In order to identify the intertemporal substitution elasticity as Pencavel (1986) stresses, one needs to assume that the intercept (and the marginal utility of initial wealth contained in it) is constant for all age groups or, if this is not the case, one must assume that the intercept is distributed independently of the $\overline{\log w_t}$. If also the latter condition is not satisfied, and this occurs, for instance, if the marginal utility

of initial wealth is lower for those age groups with lower wage rates at t , then the estimate of β_1 will not identify the intertemporal substitution elasticity, but will contain cohort effects. The estimate of the parameter of interest will therefore be affected by cohort bias.

The cohort bias issue is a critical point for the estimates provided by the synthetic cohort approach surveyed in this Section. Given that they use only one single cross section in order to reconstruct synthetic cohort profiles, they show to be unable to distinguish cohort from ageing effects and to address cohort bias.

However, the similarity of the values of the estimates on the intertemporal substitution elasticity obtained by MaCurdy (1981) by using panel data (which can follow the same individual over time and therefore can distinguish cohort from life-cycle effects) and by Becker (1975) and Smith (1977) for male labour supply by using synthetic cohort data, leads MaCurdy (1981, p.1079) to claim that cohort effects should not be important for male labour supply.

However, it is difficult to make a similar statement for female labour supply, which, as also Smith (1977) recognizes, has changed so much over time that the cohort effects on it cannot be ignored. In Chapter 5 we will describe the changes occurred over the life cycle for married women's labour supply in the U.K. and in Germany. By using longitudinal data (which follow the same individual over time) one can see how younger cohorts are characterized by a more continuous work profile than older ones. If one uses only one cross section to reconstruct married women's work profile in the U.K., cohorts and ageing effect will average out and as a result the synthetic employment profile will be still M-shaped.

Another problem that may arise when one uses synthetic cohort data is the possibility of selection bias of the static and of the

dynamic types.¹ For instance, if one uses a cross section held in 1990 to compute the average number of hours for all individuals born in 1960, by using only the observations on hours of work of those aged 30 who were working in 1990, one faces a standard static selection bias problem which is greater the lower is the number of individuals born in 1960 who were working in 1990. Since the proportion of married women working is relatively low with respect to other groups of the population, one can state that static selection bias affects models (like the one by Smith, 1977) which use synthetic cohort data to estimate married women's labour supply. Moreover, if for certain groups of the population, like young people and elderly, the proportions of those who are working are very low, the mean value of wages or of hours of work (constructed by using only observations on people who are working and belong to those age groups) is bound to produce dynamic selection bias. In fact, being the mean values of wages or hours of work estimated only on a few individuals who may not be representative of the whole age groups of young and elderly, the resulting synthetic cohort wage or hours of work profiles may provide a distorted representation of the actual ones.

To summarize, the models surveyed in this Section suffer from the following problems (apart from the ones stressed in Section 2.1, which concern their theoretical framework):

- 1) they neglect marginal utility of wealth variable-effects in the analysis of the effect of wage changes on hours of work;
- 2) they use synthetic cohort data which can suffer from static and dynamic selection bias, and which confuse cohort and ageing effects. Moreover, the difficulty of addressing the cohort bias, suffered by synthetic cohort data, may produce estimates for

¹ This point has been raised by Killingsworth (1983) and by Heckman and MaCurdy (1980).

the parameters of the model which are not consistent and problems in identifying the intertemporal substitution elasticity. These problems can be better addressed by using pseudo panel data (obtained by following the same cohort over a time series of cross sections) or by using genuine panel data, as the models surveyed in Section 2.3 and in Chapter 3 do.

Section 2.3 - Frisch demands models with exogenous wage and separability of the utility function over time applied to panel or pseudo panel data

The models surveyed in this Section have in common the structure outlined in Section 2.1 and the use of panel or pseudo panel data for econometric estimation.

This type of models has then been estimated by using a two stage procedure (MaCurdy, 1981; Altonji, 1986, Heckman and MaCurdy, 1980). We will refer to the econometric model estimated by MaCurdy (1981) on a sample of USA prime age white married men¹ to illustrate how the theoretical model presented in Section 2.1 can lead to estimable structural form demand equation for labour supply.

MaCurdy (1981) assumes a lifetime utility function which is both separable over time and within period in consumption and leisure. In fact the chosen functional form for the lifetime utility function is:

$$(1) \quad V = \sum (\psi_{11t} C^{\omega} - \psi_{21t} H^{\alpha})$$

where ω and α are time-invariant parameters common across workers and, in order to satisfy concavity one needs: $0 < \omega < 1$ and $\alpha > 1$.

A concave utility function is one feature of a well behaved utility function and with the latter the First Order conditions are not only necessary but also sufficient for a unique solution to the individual's optimization problem.

ψ_{11t} and ψ_{21t} are age specific modifiers of tastes.

C = consumption; H = hours of work.

He assumes the following distribution for the taste for work:

$$\psi_{21t} = \sigma_1 - u_{11t}$$

¹ He used longitudinal data from the Michigan Panel Study of Income Dynamics (PSID) from 1967 to 1976. He did not select those in the poor population.

σ_i and u_{it} are unobserved factors affecting the individual choices.

He then specifies, from the Frisch demand for leisure obtained by maximizing (1) subject to a lifetime separable budget constraint, the following labour supply function which he estimates in the first stage of his application:

$$(2) \log H_{it} = F_i + bt + \delta \log W_{it} + u_{it}$$

where:

$$\delta = 1 / (\alpha - 1)$$

$$u_{it} = \delta u_{1it}$$

$$b = \delta (\rho - r)$$

r = constant interest rate

ρ = individual's rate of time preference.

$F_i = [(1/(\alpha - 1)) (\log \lambda_i - \sigma_i - \log \alpha)]$ is the individual fixed effect containing also the log of the individual marginal utility of wealth ($\log \lambda_i$) which captures all the unobservables life-cycle variables.

Therefore the use of λ -constant demand functions allows MaCurdy (1981) to characterize the individual's labour supply behaviour in his life cycle without having to introduce any assumption on the individual's behaviour outside the sample period. The use of more than one wave of panel data allows MaCurdy (1981) to eliminate F_i from equation (1) by using first-differencing.²

² This is not possible when one uses only one cross section. In this case one is forced to consider λ part of the unobservables in the error term. The problems in estimation are evident since λ can be correlated to other variables in the model like wages.

The estimate that he obtains for δ (coefficient of $\log W$ in equation 2) can be regarded as an estimate of the intertemporal substitution elasticity, i.e. of the proportional change in hours of work induced by an evolutionary change in wages. The estimate obtained for δ ranged from 0.10 (0.12) to 0.23 (0.09) depending on the estimation method followed (Standard errors are in brackets).³

In the second stage of estimation, MaCurdy (1981) regressed F_1 (which contains the log of the marginal utility of wealth) on other age-invariant variables which can determine the individual's lifetime budget constraint (like family background variables and individual's education):

$$(3) F_1 = \eta_1 Z_1 + \sum_{t=0}^T \eta_{2t} \log W_{1t} + \eta_3 A_{10} + \varepsilon_1$$

Z_1 = family background variables

A_{10} = initial wealth, proxied by a vector of age-invariant individual's variables.

Estimates of F_1 are obtained as a by-product of the first stage of estimation. He assumes that wages follow a quadratic equation in age with an intercept and slope coefficients that depend on age-invariant characteristics (like education and background variables). He then estimates the following reduced form equation for (3):

$$(4) F_1 = \phi K_1 + a_1$$

K = all age invariant variables affecting wages, property income, assets or marginal utility of initial wealth (like education,

³ MaCurdy (1981) estimates equation (2) by using first-differencing. He then uses either two stage or three stage least squares with or without time dummies. He also estimates a labour supply equation with earnings instead of wages on the right hand side.

education squared and education of parents)

a_i = disturbance term

\emptyset = vector of coefficients.

This second stage allows MaCurdy (1981) to recover estimate of the effect of a parametric change in wages on labour supply that can be used to explain labour supply differences across individuals. His results show that, if the individual's wage rates at all ages increases by 10%, then his hours of work at all ages will increase by about 0.8%, this shows that the male labour supply profile is relatively inelastic with respect to changes in the wage profile.

Also other models on life cycle male labour supply which use a framework similar to the one presented in Section 2.1, show results similar to the ones obtained by MaCurdy (1981). As also Pencavel (1986) stresses in his survey on male labour supply life cycle models, on the whole models 'based on the theoretical framework presented in Section 2.1 explain only a small part of the variation in male labour supply over the life cycle.

A critique that has been raised to MaCurdy's (1981) specification of the Frisch demand model (where the marginal utility of wealth or its logarithm appear additively and can be eliminated, as shown above, by using first-differencing on panel data) concerns the restrictions that it implies on preferences. In fact, as Blundell, Fry and Meghir (1990) show, MaCurdy's specification implies explicitly additive preferences across time and within period. We have already discussed the strong implications of intertemporal separability of lifetime utility function in Section 2.1. The assumption of within period separability between leisure and demands for consumption goods has been rejected by empirical

analysis.⁴ However, as Blundell, Fry and Meghir (1990) show, the assumption of within period additivity in MaCurdy's (1981) model can only be relaxed by imposing an assumption which is even less attractive: homothetic within period preferences. In fact homotheticity implies, as Deaton and Muellbauer (1986) show, unitary within period full-income elasticities.⁵

Browning, Deaton and Irish (1985) (we will refer to this model as to BDI) estimate a life cycle model for hours of work of U.K. prime aged men by using pseudo panel data.⁶ The estimates for the intertemporal substitution elasticity that they obtain (BDI, 1985, p.529) are close to those obtained by MaCurdy (1981) for USA prime age men. However, for manual workers BDI find that wages contribute less to the hours of work variation over the life cycle than other nonwage variables (like cohort dummies or family size).

The model applied by BDI differs from the one of MaCurdy (1981). In the former, a linear model with marginal utility of wealth constant is generated and it is estimated after differencing. This allows BDI to relax the within period additivity assumption without having to impose homothetic preferences.⁷ However, as Blundell, Fry and Meghir (1990) stress, the specification adopted by BDI implies other restrictions. For

⁴ For a test of this assumption refer to the model by Hotz, Kydland and Sedlacek (1988) which indicates that demands for consumption goods and leisure are complementary.

⁵ Similar critiques can be raised to the Frisch demand model estimated by Heckman and MaCurdy (1980).

⁶ They used Family Expenditure Survey data from 1970 to 1977. They did not include data on unemployed into the sample. Pseudo cohort data will be described more in length in Chapter 6.

⁷ Moreover, BDI consider also uncertainty in their model.

instance it implies that the intertemporal elasticity of substitution of labour supply decreases with income.⁸

Frisch demand models of the type described in Section 2.1 have also been applied to the analysis of female labour supply over the life cycle by Heckman and MaCurdy (1980, 1982). They used PSID data on 672 white married women aged 30-65 in 1968, and estimated a Frisch demand model of labour supply which allows for corner solutions. In a further application of their model, Heckman and MaCurdy (1982) found evidence of an added worker effect on female labour supply. Similar to the Frisch model estimated by MaCurdy (1981), Heckman and MaCurdy's specification allows them to recover estimates for the intertemporal substitution elasticity: the estimate obtained for female intertemporal substitution elasticity of leisure time is -0.41.

⁸ For a formal discussion of the restrictions implied by the models of BDI refer to Blundell (1987) and to Blundell, Fry and Meghir (1990).

2.4 - Conclusions

In this Chapter we have shown the basic theoretical framework followed by earlier studies on life cycle labour supply: the Frisch demand model with exogenous wages and intertemporal separability of the lifetime utility function. The restrictions imposed by these two assumptions have been analysed in Section 2.1. In particular we have seen how the assumptions of intertemporal separability of the lifetime utility function and of the lifetime budget constraint rule out any persistence effect in life cycle labour supply behaviour.

We have also mentioned an important problem faced by researchers in order to apply models of life cycle labour supply: the type of data that must be used. The models surveyed in Section 2.2 try to solve this problem by constructing synthetic cohort data from a single cross-section. They use a single cross-section and group the data by birth cohort. Then they compute means for each variable of interest for each group and reconstruct synthetic cohort profiles for wages, hours of work and other variables in the model. We have shown how this approach can produce static and dynamic selection bias and how this type of data cannot distinguish between cohort and ageing effects.

The disadvantages of synthetic cohort data can be avoided by using pseudo panel (which follow cohorts over time series of cross sections) or genuine panel data.⁹ These are the types of data used by the models surveyed in Section 2.3 and in the following Chapter. We have shown how by applying a first differenced Frisch

⁹ A more detailed description of these two types of data, together with a discussion on the advantages and disadvantages of both data sets for the analysis of life cycle models can be found in Chapter 6.

demand model to panel data, one can obtain estimates of the effect of evolutionary and parametric changes of wages on labour supply and one can eliminate the problem of estimating the marginal utility of wealth, which can be treated as an individual fixed effect. We have also outlined the main restrictions implied by the specifications of the Frisch Demand models surveyed in Section 2.3.

On the whole, the evidence surveyed in Section 2.3 shows that male labour supply is relatively inelastic to changes in wages, whereas the Frisch Demand model presented in Section 2.1 seems to fit better for the analysis of female labour supply over the life cycle.

However, in both cases the model presented in Section 2.1 fails to predict persistence in employment. Moreover, the evidence surveyed in the following Chapter rejects the main implications of the assumptions of intertemporal separability of the lifetime utility function and of the lifetime budget constraint. This leads us to turn our attention to life cycle models of labour supply which modify the framework presented in this Chapter by relaxing its strong assumptions and also to models which introduce fixed costs of working. A survey of these models can be found in Chapter 3, while in Chapter 4 we present a Frisch Demand model of labour supply which keeps the main structure presented in Section 2.1 but relaxes the assumption of intertemporal separability of the lifetime budget constraint.

CH.3 - RELAXING THE INTERTEMPORAL SEPARABILITY ASSUMPTIONS AND INTRODUCING FIXED COSTS OF WORKING

INTRODUCTION

The basic structure of models on life cycle labour supply has been outlined in the previous Chapter. Frisch demand models of labour supply have shown to be useful in order to recover estimates of structural parameters (like the intertemporal substitution elasticity of labour supply) and to analyse labour supply behaviour over the life cycle. However, we have seen how they can only explain a small variation of male labour supply and how their assumptions on the lifetime utility function and budget constraint are quite restrictive.

It is useful to survey the tests conducted on the the key assumptions of the models above analysed (i.e. on the intertemporal separability of the lifetime utility function and of the lifetime budget constraint) and this is what we do in Section 3.1.1.

The recent literature on life cycle labour supply shows interest in changing the basic model presented in Chapter 2. Models which relax the assumption of intertemporal separability of the lifetime utility function are surveyed in Section 3.1.2, whereas the models which relax the assumption of separability of the budget constraint over time are analysed in Section 3.1.3.

In the previous Chapter we have not devoted attention to the effect of fixed costs of working on labour supply. However, as the analyses surveyed in Section 3.2.1 show, fixed costs of working have been found to be important in affecting labour supply in a static setting. Their effect in a simple dynamic model of labour supply (which does not relax the assumptions of intertemporal separability of the lifetime utility function and of the budget constraint) is analysed in Section 3.2.2..

In Section 3.3 we summarize the main results of the analysis conducted in this Chapter which bring us to choose the particular model of life cycle labour supply presented in Chapter 4.

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SECTION 3.1 - RELAXING THE INTERTEMPORAL SEPARABILITY ASSUMPTIONS
OF THE LIFETIME UTILITY FUNCTION AND
OF THE LIFETIME BUDGET CONSTRAINT

3.1.1 - Evidence against the intertemporal separability
assumptions

The Frisch demand models described in Chapter 2 have in common the assumptions of intertemporal separability of the lifetime utility function and the assumption of intertemporal separability of the lifetime budget constraint. Each one of them implies that current hours of work do not affect forward employment behaviour. They rule out any persistence effect in the life cycle behaviour of labour supply, as we have discussed in the previous Chapter.

However, there is evidence on the existence of this persistence effect for both male and female labour supply. Mankiw, Rotemberg and Summers (1985) and Clark and Summers (1982) found evidence in favour of a strong persistence effect. According to this effect short run increases in employment will tend to persist as workers stay in the labour market because of habit, adjustment costs or human capital accumulation. Also Altonji's (1982) analysis casts serious doubts on the validity of strong substitution of leisure between different periods, which is an implication of the intertemporal separability of the lifetime utility function as we have seen in Section 2.1.

By using a sample of married women taken from the Panel Study of Income Dynamics, Heckman (1981) found that past work experience affects significantly current decisions of employment for women in post-childbearing years, whereas the effect of past work experience on the current decision of labour supply of women of younger cohorts is weaker. Also Johnson and Pencavel (1984) in

their analysis on USA - Negative Income Tax (NIT) data found evidence of state dependence. Evidence in favour of a positive effect of past work experience on the current decision of working is also found by Joshi, Layard and Owen (1985) for British women in all age groups.

Under the Frisch demand model presented in Chapter 2, the individual is able to adjust his hours of work over the life cycle in response to changes in wages. Unemployment is assimilated to any other voluntary use of nonmarket time. The individual decides about being unemployed on the basis of a comparison between forward and current wages. Therefore unemployment represents an intertemporal labour supply behaviour of the individual. This hypothesis has been tested by Ham (1986) by applying a life cycle model of the type presented in Chapter 2 to USA Panel Study of Income Dynamics (PSID) data on prime aged men (from 1971 to 1979 waves)

Ham (1986) introduced in the hours of work first differenced function of his life cycle model, dummies for the unemployment and underemployment status or a variable accounting for the hours in unemployment. Since the coefficients of these variables were found to be significantly different from zero, also under different specifications (for instance by using a nonlinear specification and by dropping the assumption of within period separability between consumption and leisure in the utility function) different sample selections ¹ and different unemployment definitions, Ham rejected the hypothesis that unemployment represents an intertemporal labour supply behaviour.² Prime aged male unemployment does not appear to be explained by substitution in

¹ Ham also tried a sample similar to the one used by MaCurdy (1981) who excluded the poverty sample from his PSID sample as shown in Chapter 2.

² Refer to MaCurdy (1990) for a critical analysis of tests on the intertemporal substitution hypothesis.

-

the intertemporally separable life cycle model that Ham has estimated. He also found that if one controls for unemployment by simply adding in the standard life cycle labour supply model (of the type presented in Ch.2) unemployment hours or dummies one does not produce a satisfactory empirical model of labour supply. Therefore he proposed to follow two main approaches:

- 1) turn to models of the labour market which do not consider the unemployed as being on their labour supply curve (as implicit contracts or search models);
- 2) turn to more sophisticated models of intertemporal substitution. One solution, that Ham suggests, is to relax the intertemporal separability assumption of the lifetime utility function to allow current utility to depend on lagged hours of work.

One of the implications of assuming an intertemporal separable lifetime budget constraint is that wages are assumed to be exogenous, the model excludes any effect of past work experience on current wages. However, this is in sharp contrast with the evidence provided by many human capital models of wages which include past work experience as a form of learning by doing human capital,³ and it is also in contrast with the possibility that wages increase over time for seniority reasons (the longer the individual stays in a given job). Excluding the effect of past work experience on current wages, as we have shown in Section 2.1, again rules out any persistence effect in life cycle labour supply behaviour.

As we have shown in this Section, different sources of empirical evidence lead to the same point: the need of relaxing

³ For a survey of these models and their implications for labour supply analysis refer to Killingsworth (1983), Weiss (1986) and Willis (1986).

the intertemporal separability assumption of the lifetime utility function or of the lifetime budget constraint in order to account for the persistence effect in the individual life cycle employment behaviour and to provide more satisfactory empirical models of life cycle labour supply.

However, one should notice that it is very difficult to choose whether to relax the assumption of intertemporal separability of the lifetime utility function or the assumption of intertemporally separable lifetime budget constraints, since by relaxing each one of them one can account for the persistence effect that the literature finds in empirical research. Actually, as Browning (1988) has shown, one can generate the same demand function either by using non-additive preferences with over time additive budget constraints or by using additive preferences and non-additive budget constraints.

With this identification problem in mind, we turn now to analyse those models which relax the assumption of intertemporal separability of the lifetime utility function and the main reasons that stay behind nonseparable preferences (Section 3.1.2) and to the analysis of models which relax the assumption of over time additivity of the budget constraints (Section 3.1.3).

Section 3.1.2 - Relaxing the intertemporal separability assumption of the lifetime utility function

In the previous Section we have discussed the evidence existent against the intertemporal separability assumptions made by the Frisch demand models presented in Chapter 2. We have also outlined the identification problem arising from the difficulty of identifying the causes of the observed non-additive behaviour of labour supply over the life cycle. Here we will highlight those factors that can lead to the need of relaxing one of the intertemporal separability assumptions made by the model presented in Chapter 2: the intertemporal separability of the lifetime utility function. Amongst them one can consider factors which lead to contradict one of the most important implications of the assumption of intertemporal separability of the lifetime utility function: that current decision on the allocation of time depends only on current variables and on current marginal utility of wealth which, given no aggregate shocks will remain constant. Amongst these factors one can consider:

1) job search: if one includes job search activity in the model, one should consider the effect that current job search activity has on forward wages and on the probability of finding a job. Current decision on the allocation of time is therefore going to affect forward employment behaviour;

2) unemployment duration and duration of spell out of the labour force. Evidence has been provided on the negative correlation existing between duration of unemployment and the probability of being employed, and between the duration of periods spent out of the labour force (for instance by women for childrearing reasons) and the employment probability in subsequent periods.¹ Again this implies that

¹ Refer for instance to the evidence on male labour supply provided by Gönül (1987) on the decrease in the employment probability with the duration of non-employment. Refer also to the evidence provided in

current decision on the allocation of time affects forward allocation of time decisions. However, this effect may be induced by the depreciation of the human capital stock which affects wages and one can account for it by relaxing the intertemporal separability assumption of the lifetime budget constraint rather than by directly including lagged employment status in the utility function.

3) contracts or institutionally fixed hours. These factors limit the individual's ability to decide about his allocation of time over his life cycle. A contract with an employer signed at time t may imply that the worker must provide a fixed number of hours of work also at time $t+1$. Again the decision taken at time t can affect forward decisions on the allocation of time;

4) habit formation. An individual may get used to working a certain number of hours over a given period of time and feel that changing his habits is costly. Therefore lagged hours of work, and also forward hours of work (if the individual has rational habit formation) enter the current utility function and the assumption of separable preferences over time must be relaxed.²

5) inclusion of human capital accumulation in home production. Hotz, Kydland and Sedlacek (1988) did so by including past values of nonmarket time (as durables) in the production of household's commodities and the latter enter as arguments in the current utility function.

This implies that past nonmarket time activities affect the current decision on labour supply and contradicts the

Chapter 5 on the reduced probability of working full-time, experienced by British married women when they return to work after interruptions.

² For analyses on habit formation and models including it in life cycle labour supply refer to Bover (1986) and to Kapteyn and Woittiez (1990). As we will discuss in the following Section, the existence of habit persistence in a life cycle model of female labour supply which endogeneizes wages has been rejected by Eckstein and Wolpin (1989).

implication of the assumption of intertemporal separability of the lifetime utility function mentioned above. Moreover, it may imply that leisure times at different dates are complements contrary to another implication of the assumption of intertemporal separability of the lifetime utility function that, if leisure is a normal good, leisure times at different dates are substitutes.

One can relax the assumption of intertemporal separability of the lifetime utility function by imposing over time nonseparable preferences in the individual's utility function. This can be done by using partial adjustment, or habit models of labour supply. In both models lagged leisure enters directly the utility function.³

This way has been followed amongst others by Hotz, Kydland and Sedlacek (1988) and by Bover (1986) for analyses on men's labour supply and by Arellano and Bover (1988) to study female labour supply.⁴

The model estimated by Hotz, Kydland and Sedlacek (1988)' (thereafter we will refer to their paper as to HKS) allows a test for the restriction of intertemporal separability of the utility function. In fact they include in the instantaneous utility function a variable (Z_t) which is a distributed lag of current and past leisure:

$$Z_t = 1 + \alpha a_t$$

³ However, together with Ham (1986), one must notice that in these models it is always difficult to identify why lagged hours of work are important. This may occur because of preferences, costs of adjustment or also because of individual's heterogeneity. For instance there may be individuals who dislike working less intensely than others and therefore stay more continuously in the labour market because of an individual specific fixed effect attributable to heterogeneity rather than to nonseparability of preferences over time.

⁴ These studies use the USA Panel Study of Income Dynamics. The sample chosen by Hotz et al. is directly comparable to the one selected by MaCurdy (1981).

As HKS stress, Z can be interpreted as a household's commodity produced by using two inputs:

l_t = current non market time and

$$a_t = (1-\eta) a_{t-1} + l_{t-1} = \sum_{s=1}^{t-t} (1-\eta)^{s-1} l_{t-s}$$

a_t can be considered as a durable good which represents a stock of homemaking skills that one has acquired over his life cycle and which is made up of past periods of non market time with depreciation rate equal to η .

$0 < \eta \leq 1$ and when $\eta=1$ the above model, as HKS (1988) stress, reduces to the model of Johnson and Pencavel (1984).

α measures the importance of all terms in past leisure relatively to the current term in leisure in the current utility function.

If $\alpha = 0$ preferences are additively separable in leisure over time. Therefore, $\alpha = 0$ is the restriction accounting for intertemporal separability in the utility function. As they pointed out if $\alpha=0$ their model reduces to the one by MaCurdy (1981) that we have surveyed in Chapter 2.

The evidence provided by the estimation of their model, leads HKS to reject the assumption of intertemporally and contemporaneous separable utility function. They also reject Johnson and Pencavel's specification (1984) where only last year's hours of leisure enter the current utility function, in favour of a more general model where also earlier years of leisure hours enter the current utility function.

Also Bover (1986) relaxes the intertemporal separability assumption by allowing for nonseparable preferences. She uses for this aim three different models: a partial adjustment model and two habit models.

1) Partial Adjustment Model: She assumes that the change in hours of work is a proportion of the difference between desired level of hours of work at t (the current period) and the actual hours supplied during the previous period. The desired level of hours at t is then estimated

by maximizing the lifetime utility function where future wages enter the equation in their expected values.

2) She uses two types of habit models:

2.1 - a myopic habit model where the worker does not care about the effect that his decision on current labour supply will have on future utility and therefore his utility function at t has the following form:

$$U_{it} = U(h_{it} - \phi h_{it-1}, c_{it}) + [1/(1 + \rho)]$$

$$\cdot U(h_{it+1} - \phi h_{it}, c_{it+1})$$

where ρ is the time preference factor, h_{it} are the hours of work of individual i at time t , C is consumption and ϕ is a habit persistence measure.

2.2 a rational habit model where the individual takes into account also the current hours of work decision in the utility function. His utility function for time t will then be:

$$U_{it} = U(h_{it} - \phi h_{it-1}, c_{it}) + [1/(1 + \rho)] \cdot U(h_{it+1} - \phi h_{it}, c_{it+1})$$

By estimating the three models on Panel Study of Income Dynamics (PSID) data on white men employed from 1970 to 1976, she gets significant and large coefficients for lagged hours of work in the current hours of work function which again is another evidence against the intertemporal separability assumption of the lifetime utility function. However, it is difficult to disentangle which of the three different models proposed is more likely to cause the observed lagged response in the hours of work estimation.

As we have stressed in Section 3.1.1, there may also be other sources of state dependence than nonseparable preferences. HKS (1988) test for the existence of these different sources of state dependence, and though the results of the tests performed are not conclusive, they do reject the hypothesis of wage exogeneity in the model. In the

following Section we will survey those models that relax the wage exogeneity assumption. We will relax the assumption of wage exogeneity explicitly in the dynamic model presented in Chapter 4, by allowing for on the job human capital accumulation and therefore by concentrating on that source of state dependence neglected by HKS (1988).⁵

⁵ We find interesting the point raised by HKS (1988) on the trade off which one faces between relaxing the intertemporal separability assumption and accounting for the increase in the number of variables measured with error in the model.

Section 3.1.3 - Dynamic labour supply models with endogenous wage

In this Section we discuss the implications of allowing for wage endogeneity in a static and in a dynamic model of labour supply. We will survey the dynamic models of labour supply where wages are, at least in part, a function of past work experience, and that therefore relax the assumption of intertemporal separability of the lifetime budget constraint. We leave aside models where wages are function only of "pure training human capital" since the latter yield rather unrealistic predictions of the wage profile over the life cycle. In fact they imply that the wage rate falls towards the end of the life cycle while the empirical evidence (for instance the one produced by Becker (1975) and by Mincer (1974)) shows that wage increases monotonically over the life-cycle.¹

The introduction of endogenous wages in a static model of labour supply with a linear budget constraint will produce a nonlinearity in the budget constraint. It will also lower wages elasticity of labour supply as Moffitt (1984a) showed.²

Allowing for wage endogeneity in the static model generates also a more realistic prediction of the average woman's hours of work distribution, with a bimodal distribution peaking at zero and at

¹ For a survey on the "pure training" models of labour supply refer to Killingsworth (1982, pp.263-265 and 1983, pp.310-314) who also raised the point regarding the unrealistic wage profile implied by these models. For analyses on human capital earnings functions and life cycle earnings profiles refer to Willis (1986) and to Weiss (1986).

² He estimates simultaneously a labour supply function for the worker and the wage-hours locus offered by the employer by using the 1972 National Longitudinal Survey on older women. He specified a wage equation of the type:

$$W_i = Z_i \Psi + b H_i + c H_i^2 + v_i$$

where the wage is a function of Z_i (a vector of socioeconomic characteristics: race, age, years of schooling, size of the local labour force and employment fraction in manufacturing and government in the census region of residence) and hours of work for the i -th individual (H_i).

full-time hours of work (Moffitt, 1984a, p.562) with respect to the one obtained by the standard Tobit model of labour supply with linear budget constraint.

The implications of the introduction of wage endogeneity in a life cycle model of labour supply are even stronger. In fact, in the dynamic setting, the assumption that wage rates are related to past work experience breaks the intertemporal separability assumption of the lifetime budget constraint and this can modify the whole lifetime optimizing work profile for the individual.

There are only a few models of dynamic labour supply which relax the intertemporal separability assumption of the lifetime budget constraint by introducing endogenous wages. Amongst them one can refer to the models which assume wages to depend only on past work experience as the "learning-by-doing models", following Weiss' (1972) definition.

In the "pure training models" one can distinguish between investment in training and pure hours of work either by specifying the amount of training implicit in each job, or by specifying the problem of choice in terms of allocation of time between pure working and pure training activities (as in Ghez and Becker, 1975 and in Heckman's, 1976, models).

Differently from pure training models, the "learning-by-doing models" are characterized by the assumption that market activity is in itself productive of human capital and so in these models training cannot be avoided when one decides to work a positive number of hours.

The idea of introducing past work experience in the wage equation was present also in the model formulated by Fisher (1971, Ch.2) who introduced past work experience explicitly in his "individual's skill function". Weiss (1972) formalized this idea in his "learning-by-doing" model which bears interesting implications as regards the possible optimal work profile over the

life cycle though he does not test them empirically. However, as also Killingsworth (1983, p.315) stresses, Weiss' model as most of the learning-by-doing models:

"may be too general to be entirely satisfactory. Almost any kind of labor supply profile could be consistent with that model, making one wonder whether it has been formulated in a way that makes it refutable".

In fact different paths of labour supply over the life cycle will arise depending on the relative size of the subjective rate of time preference (ρ), the interest rate (r), and the depreciation rate of human capital (δ), with an increasing work profile when ρ is greater than $(r + \delta)$ and a decreasing work profile if $\rho = 0$.³

Amongst the more recent empirical models on labour supply which endogeneize wages in a dynamic setting one can consider the analyses by McCabe (1983)⁴, Moffitt (1984b),⁵ Nakamura and Nakamura (1985a, 1985b), Eckstein and Wolpin (1989), and Altug and Miller (1991) on women's labour supply and Shaw (1989) on male labour supply.

The most relevant findings of the above applications which enter past work experience in the wage equation are:

1) change in the wage profile for women over their life cycle.

³ Where both r and δ lead to a decreasing trend of labour supply over the lifetime while if ρ is greater than 0 this will lead to a postponement of labour supply later in life.

⁴ He shows how a non concave earnings function can generate rather surprising consumption patterns as in the Blinder and Weiss' (1976) model where an increase in the initial value of wealth produces a decrease in consumption during each period of time with a convex earnings function. This stresses the need for satisfaction of the sufficient condition for the optimal control problem (i.e. the concavity of the Hamiltonian with respect to the state variables) to get sensible results. He does not provide an empirical application of his model.

⁵ Moffitt (1984b) applies a life cycle model of joint fertility and labour supply decisions on a sample of married women drawn from the National Survey of young women from 1968 to 1975.

Moffitt's (1984b) model generates an increasing wage profile for married women. A further analysis made by Moffitt (1984b) on the impact of childbirth on the employment and wage profiles shows that childbirth shifts downward the wage profile which results sensibly lowered in its absolute level by the birth of a child, and also by subsequent new births in the family.

2) change in the employment profile for women over their life cycle with respect to the profile obtained when one neglects past work experience in the wage equation. By applying his model, Moffitt (1984b) finds an initially decreasing and then increasing employment profile for married women, which is lowered by childbirth.

In general it has been found that a model which neglects the person specific effects embedded in the previous work behaviour, fails to predict the continuity in work behaviour of the individual.

The Heckman's model applied to only one cross-section neglecting past work experience [referred by Nakamura and Nakamura (1985a and b) as the "Standard model"] has been found to predict more changes in the work status for women than the ones actually observed.⁶

3) improvement in the prediction of employment and wages of women over time. In their model on women's labour supply, Nakamura and Nakamura (1985a) obtain a sensible improvement in the prediction of employment and wages of women over time, even by adding only a dummy variable which takes the value of one if the woman has worked in the previous year and zero otherwise.

4) positive effect of past work experience on current wages, and through this on current employment probability.

⁶ Refer to Nakamura and Nakamura (1985a and b) and to Heckman (1981).

In particular, Eckstein and Wolpin (1989) find that the positive effect of work experience on current female labour supply is due to the positive effect of past work experience on wages (leading to positive state dependence) which more than offsets the positive impact of experience on the disutility of working (which would lead to negative state dependence). They find that this persistence effect due to state dependence remains also when they allow for unobserved heterogeneity in preferences for work in their model. Unobserved heterogeneity can explain persistence in employment. For instance, one can claim that there are individuals who may dislike working less intensely than others and by this way they tend to stay more continuously in employment showing persistence. They introduce heterogeneity in the model by using a fixed-effect model with an individual fixed effect which changes according to whether the individual switched her employment status.

It is interesting to notice that they do not find evidence of habit persistence, since they cannot reject the null hypothesis that the coefficient of a term in lagged hours of work directly included in the utility function equals 0.

5) a positive and significant interaction term between schooling and post-school human capital multiplied by wages. This result has been found by Shaw (1989) in her analysis on male labour supply. This suggests that education augments post-school investments in human capital or that the two are complements.

6) the rates of returns to the stock of human capital vary from year to year. This idea, suggested by Killingsworth's (1982) joint experience-training model, has been confirmed by the model estimated by Shaw (1989) on male labour supply.

7) more recent past work experience has a larger impact on wages

and on the employment probability of married women. In particular, this has been found by Nakamura and Nakamura (1985b) by comparing the results of the estimation of their "inertia model" to other models of labour supply,⁷ and by Altug and Miller (1991).⁸ According to these results, by including more information on past work-experience one does not sensibly improve the goodness of fit of the model and if this result can be generalized, sensible gains in terms of the quality of the data available and in terms of the computational procedure necessary to get information on past work experience can be achieved. For instance if only previous year's work experience is necessary, one can use census data with recall questions on previous work experience instead of using panel data which have attrition problems, are more costly to collect, and are not always available.

On the other hand, different results on the impact of past work experience on tastes have been obtained by Hotz, Kydland and Sedlacek (1988). As we have discussed in the previous Section, they reject a model where only last year's hours of leisure enter the current utility function in favour of a more general model where also earlier years of leisure enter the current utility function.

8) The introduction of past work experience as explanatory variable in the model brings about a reduction of the effect of

⁷ The Inertia Model, differently from the difference model of Nakamura and Nakamura (1985a), does not express the wage and hours of work equations for those women who worked in the previous year in first difference form, but includes explicitly the lagged dependent variables as explanatory variables together with other undifferenced variables (like age and education) to account for unobservable individual specific effect.

⁸ Another important feature of Altug and Miller's (1991) model is that they found evidence for nonseparable preferences only when they ignore aggregate shocks in their model on dynamic labour supply, while past work experience has always a positive effect through wages. They stress how, by ignoring aggregate shocks, one can get biased estimates.

"child" variables on female labour supply. This has been found amongst others by Nakamura and Nakamura (1985b). This may arise because past work experience picks up the effect of some unobservables otherwise included in fertility variables.

9) education increases the disutility of work (this can arise when schooling enhances home production) but this direct effect on the utility function is more than offset by the positive effect that schooling has on wages and through them on the current employment probability. This result has been found by Eckstein and Wolpin (1989). Moffitt (1984b) finds that the positive effect of education on the employment profile is due to its positive and significant impact on the wage profile, whereas its direct impact on tastes is not significant.

10) policy implications of neglecting the impact of past work experience on wages.

As we have discussed in Chapter 2, if one neglects the effect of past work experience on current wages, one excludes from the leisure demand equation a term in the expected present value of the marginal effect of current hours of work on future wages weighted by future hours of work. We will formally explain how this term arises in the following Chapter. Now we concentrate on the implications of its exclusion in empirical research and for policy analysis.

As Shaw (1989) stresses this exclusion can cause an omitted variables bias which will be greater the greater is the impact of past work experience on current wages. She shows that by adding to the current wage (which, in the standard dynamic model surveyed in Chapter 2, is the only marginal benefit of current hours of work) also the marginal benefit connected with the effect of current hours of work on all future wage rates, the intertemporal substitution elasticity raises over time instead of being constant. This in turns implies that policy changes which vary the net benefit of working (like lower tax rates) will have a

significant distributional impact. In fact, given the existence of an increasing intertemporal substitution elasticity, (that standard dynamic models, which do not relax the assumption of intertemporal separability of the lifetime budget constraint, would have neglected) younger workers would be less responsive to the lowering of tax rates, than older workers. Therefore, dynamic models which consider wages to be exogenous may produce misleading results when they analyse the volatility of youth employment or the effects of tax changes on labour supply over the life cycle, as Shaw (1989) stresses.

SECTION 3.2 - FIXED COSTS OF WORKING

The models surveyed in Chapter 2, generally neglect an important component of labour supply choice: the existence of fixed costs of working. This topic will be discussed in this Section.

There are different types of fixed costs that an individual has to bear in order to start or to continue to work in the labour market. These can be distinguished in fixed money costs (for instance costs of child care or transportation costs) and in fixed time costs (time devoted in searching childcare arrangements, or time devoted to child care, and commuting). In this Section we will consider mainly fixed costs of working connected to child birth and to the presence in the household of young children.

Notwithstanding the importance of fixed costs of working in the analysis of married women labour supply stressed amongst others by Hausman (1980, 1981), Cogan (1980) and Killingsworth (1983), the literature on this subject is still small and it has been mainly developed under a static model of labour supply.

Amongst the models which explicitly introduce fixed costs of working in their structure there are the ones of Cogan (1980, 1981), Heckman (1974) and Hausman (1980).¹ Wales (1978) considers commuting hours of the head of the family and its relation with housing in the utility function of the household.² Blundell, Ham and Meghir (1988) introduce fixed costs of working in their model and estimate the impact of them in discouraging individuals from job search.

¹ For an analysis of these first models refer to Killingsworth (1983).

² However, the difficulties in measuring housing and the fact that Wales' model does not consider other effects that in our opinion are more important than the commuting time of the head of the family in determining housing, together with the poor results obtained leave us quite sceptical about the introduction of this type of fixed costs in the model.

Fixed costs of working have been considered by Clark and Summers (1982), as a possible source of persistence in the labour supply function, but they do not explicitly test for this effect in their 1982 model. Eckstein and Wolpin (1989) introduce fixed costs in their model but they do not account for them in its empirical specification.

We will first deal with the effect of fixed costs in the static model of labour supply as it has been discussed in the existing literature on fixed costs (Section 3.2.1), then we will analyse their effect in a simple dynamic setting without corner solutions (Section 3.2.2). Fixed costs of working related to the birth of an additional child will then be embedded in our model of labour supply and a first discussion of their effect when wages depend on past work experience (and therefore the intertemporal separability assumption of the lifetime budget constraint is relaxed) can be found in Chapter 4.

3.2.1 - Fixed costs of working in static models of labour supply

In a static model of labour supply fixed money costs enter the model via the budget constraint. Women who are already working will be working harder as long as the fixed costs of working are not so high to make their reservation wage higher than the offered market wage.³ So some women with a relatively high level of reservation wage may be induced, by the introduction of fixed money costs of working to drop out of the labour force and the net effect on the number of hours worked will depend on how high is the reduction in their labour force participation rate.⁴

³ Refer to Killingsworth (1983, p.24) for a graphic analysis of this point.

⁴ This statement is in contrast with the claim that an increase in fixed money cost of working will certainly increase the hours of

Fixed time costs enter the static model of labour supply by reducing the time available either for working in the labour market or for other nonmarket activities so they will result in a reduction of hours of work and of non market time. The introduction of fixed costs of working induces discontinuities in the labour supply curve for the individual since to cover the cost connected with entering the labour market work the individual must work at least a minimum number of hours (say H_g) called reservation hours.⁵

Therefore fixed costs models offer an explanation for the existence of minimum hours of work in the labour supply curve. However, as it has already been stressed by Cogan (1981), there are other institutional factors, like collective agreements or employer's needs, that seem to determine the minimum number of hours at the reservation wage rather than the fixed costs of working argument. Notwithstanding the more relevant role that the latter factors have in determining the minimum number of hours, in our opinion, fixed costs of working (for instance fixed money or time costs connected with the birth of an additional child) may still be responsible for the smaller access of women to higher positions which require additional hours of work or more flexibility of working time, as long as the market wage is not higher enough to cover the fixed costs connected to the new working conditions. Take for instance the decision faced by a woman with young children if she had access to a job which

work for those who were already working before, claim made for instance by Cogan (1981, p.948) and by Killingsworth (1983, p.28). In making this claim they seem to neglect the effect of the introduction of fixed money costs of working on the relative size of the reservation wage, effect that they consider however when dealing with the definition of the reservation hours of work (i.e. the minimum number of hours that the individual is willing to work at the reservation wage when fixed costs of working are introduced).

⁵ This has been shown amongst others by Cogan (1981, p.947).

requires overtime hours of work, or a greater availability to schedule her working time on the basis of the firm's needs. If, as it is in Italy and in West Germany, childcare facilities are supplied at a relatively low price only during a limited and fixed number of hours per day and per week, if other services offered by the market are very expensive and her time devoted to childcare has no other substitutes in the family, her decision will be seriously affected by the existence of the fixed costs of working in the new position.⁶

In the following we will deal mainly with fixed time and money costs connected with the existence in the family of preschool children, by considering also the effect of the existence of different systems of payment of childcare facilities and the availability of childcare benefits.⁷

As a way of distinguishing between fixed money and time costs of working it has been suggested (Killingsworth, 1983) to add a term dependent on wages (under the assumption that only the latter type of fixed costs will be wage-dependent). However, in the case of fixed costs related to child care, also the money costs can

⁶ There is evidence in Italy of a relatively low wage differential when moving up from the positions in the Public Sector or in the other positions usually covered by women, and this will reinforce the effect of fixed costs of working in discouraging upward mobility of women workers.

⁷ Heckman (1974) tries to estimate indifference curves between money income and nonmarket activities in order to explain the effect of child-care programs (like the one introduced under Nixon's administration in the USA) which provide work-related childcare benefits. He uses National Longitudinal Survey (NLS) 1966 data on married women aged 30-44 with one child under ten, and data on informal and formal childcare arrangements. He introduced fixed costs in the reservation wage equation and treats fixed costs as a stochastic function. It would be useful to allow also for substitutability between money and time costs as Cogan (1980) does by introducing a convex money entry cost curve in his model of static labour supply.

depend on wages (for instance this is the case when the system of payment is related to the family income or when women with different wage levels have access to different type of childcare bearing different prices).⁸

By stratifying the sample by cohort and education level as well as by number and age of children it is possible to analyse the impact of these variables on fixed costs of working. Consistently with Cogan (1980) findings, one can expect that children in preschool age will raise the cost substantially, those in elementary school age will raise it only in a small measure, and children in high school age will reduce it. It will also be possible to disentangle the effect of ageing and the cohort effect on fixed costs of working.

Additional education according to the existent literature on fixed costs is expected to increase fixed costs of working for three reasons, and to decrease it for one:

- 1) additional education by increasing the productivity of women in the nonmarket activities will decrease their fixed time costs (Michael, 1973);
- 2) better educated women have been found [Hill and Stafford (1974) and Leibowitz (1975)] to attach more value to non market activities and so they will have higher fixed time costs of working;
- 3) as long as better educated women have access to jobs which

⁸ By analysing the available data on women's job search, the impact of fixed costs related to additional child on it can also be estimated. Data on job searchers are available for Italy using the quarterly labour force survey data, and for the U.K. using the Family Expenditure Survey. The procedure followed by Blundell, Ham and Meghir (1988) to disentangle the effect of fixed costs of working from the effect of search costs in job search activity can be followed. They estimate, by using 1981 FES data, that approximately 22% of non participation is determined, amongst women, by fixed working costs and more than 15% is determined by search costs.

require higher expenditures in clothes and other similar goods, additional education will produce higher fixed money costs of working;

4) Cogan (1981) claims that more educated women have been found to live in higher income houses and since they are usually far away from business centres additional education will indirectly cause an increase in fixed money costs of transportation as well as fixed time costs of commuting.

However, since we will mainly deal with fixed costs of working related to childcare we will leave aside the two last effects, and we will consider only the first two effects of education on the impact of fixed time costs of working which are opposite in sign and bring about an ambiguous effect of the increased level of education experienced by younger cohorts of women. Heckman (1974) found that for white women with at least one child under 10 years of age, better educated women are more likely to be out of the labour force than less educated women, while that is not true for nonwhite women.

As Nakamura and Nakamura (1985b) stress the effect of fixed costs of working related to having children may be different for women who work continuously (i.e. women in the labour force in the previous survey) and women who are just entering the labour force. The latter have to bear the additional cost of searching childcare arrangements whereas the former only bear the cost of childcare. One can allow for this systematic difference in the impact of fixed costs by estimating different equations for the two different groups of women as also Nakamura and Nakamura (1985b) did.

3.2.2 - Fixed costs of working in dynamic models of labour supply

In this Section we analyse the effect of fixed costs of working in a dynamic model of labour supply. We will not consider in this Section the corner solutions which may arise if the fixed costs of working are high enough to make the reservation wage higher than the market wage.

Since we will consider fixed costs of working in a dynamic model of female labour supply special care should be devoted in analysing the possible short run and long run effects of the introduction of fixed costs of working. On this point we can notice how ambiguous is the effect of child birth on fixed costs in the long run. In fact:

- on one hand, as Cogan (1980) points out, women may be induced in the long run to decrease fixed time costs by choosing arrangements that are less intensive in their time. Therefore, an increase in the working woman's wage might not induce her in changing child care arrangements in the short run, but changes can occur in the long run;
- on the other hand, in the long run there will be an increase in fixed money costs connected with the ageing of children. In fact, it has been found that older children are more goods than time intensive.

Fixed time costs tend to decrease in the long run, while fixed money costs rise. Therefore the net effect of child birth on fixed costs in the long run will be ambiguous and in considering the long run effect of an increase in mother's market wage, one has to take into account this.

In order to cast more light on the effects of fixed costs of working on labour supply in a dynamic setting, we start by entering fixed costs of working in a simple dynamic model of the type described in Chapter 2, with exogenous wages and no bequests, and without relaxing the assumption of intertemporal separability of the lifetime utility function.

In this framework the introduction of fixed money costs does not affect wages. They enter into the budget constraint since they must be subtracted from the value of initial assets:

$$\int_0^T Z_0 = Z_0 - \int_0^T e^{-rt} F_t dt$$

where the fixed costs born at time t [F_t] are the equivalent of $e^{-rt} * F_t$ incurred at time 0. If one wants to account also for corner solutions a multiplicative dummy which takes the value of 0 if the woman does not work can be added to the fixed cost term.

The first order condition with respect to the marginal utility of initial assets (λ) then becomes:

$$\partial L / \partial \lambda = Z_0 - \int_0^T e^{-rt} F_t dt + \int_0^T e^{-rt} [W_t H_t - P_t C_t] dt = 0$$

The introduction of a fixed money cost at time t' (even if it will not be present in other periods) through the change in the lifetime budget constraint will lead to $Z_T < 0$. To offset this effect on her terminal assets (which cannot be negative by assumption) the individual will have to increase the shadow value that she attaches on her initial assets Z_0 , λ increases and the individual will therefore spend less in consumption and leisure not only at t' but also in the following periods. Therefore for a working woman the introduction of fixed money costs at time t' leads to an increase of her hours of work also in the following periods via the λ variable effect provided that fixed costs are unanticipated at $t < t'$.

If fertility is a choice variable, the fixed time costs associated with having an additional child can be regarded as anticipated costs, so they will not lead to shift into the labour supply function, but to displacement over the life cycle (if leisure is a normal good and there is strong intertemporal substitution of leisure). Fixed time costs can then be seen as a lump sum anticipated reduction in women's wage and if leisure can be substituted amongst nearby periods and there are no constraints this will lead to a reduction in the hours of work of women at time t and in an increase of her hours of work in subsequent periods.

The introduction of an unanticipated time cost in period t will lead on the other hand to a decrease in labour supply (expressed in terms of hours of work) and time devoted to other non-market activities (λ constant effect). In turn, this reduction will cause λ to increase (even if the time cost is born by the woman only at time t) and so there will be a λ variable effect that brings about an increase in hours of work and a reduction in expenditure in consumption and leisure. Therefore the effect of an increase in time costs at t on hours of work will be ambiguous. If the λ variable effect is lower than the direct (λ constant) effect, working women will reduce their hours of work at t , but in the following periods (when the time costs are not present) only the indirect (λ variable) effect will be at work and so working women will increase their supply of work in the market. If the time cost of working is constant and spread over time (for example, commuting time) and it is not a lump sum cost the effect on the hours worked will be ambiguous over the whole working life.

Section 3.3 - Conclusions

In this Chapter we have dealt with two major ways of modifying the dynamic model presented in Chapter 2:

- relaxing the assumptions of intertemporal separability of the lifetime utility function and of the lifetime budget constraint (Section 3.1);
- adding fixed costs of working (Section 3.2).

The evidence surveyed in this Chapter has shown how strong are the implications of the assumptions of intertemporal separability of the lifetime utility function and of the budget constraint discussed in the previous Chapter. The models analysed in Section 3.1.1 show evidence of persistence effect in the employment behaviour over the life cycle which is rejected by each one of the two intertemporal separability assumptions mentioned above. This poses also an identification problem, since, as discussed in Section 3.1.1, the observed nonseparable behaviour of labour supply over the life cycle can be generated either by introducing nonseparable preferences and by keeping the intertemporal separability assumption of the lifetime budget constraint, or by keeping lifetime separable preferences and by introducing nonseparable lifetime budgets constraints.

As stressed in Chapter 2, the assumption of a lifetime separable budget constraint rules out the possibility that current wages depend on past work experience. However, as we have discussed in Section 3.1.1, this is in sharp contrast with the existing evidence on wages dynamics.

In Section 3.1.2, we have analysed some factors which can justify the need of relaxing the intertemporal separability assumption of the lifetime utility function (amongst them: search costs, contracts, habit formation). The results of the application of partial adjustment and habit models of labour supply, which relax the assumption of a lifetime separable utility function,

have been surveyed in Section 3.1.2. We have noticed that it is difficult, on the basis of the evidence provided by these models, to disentangle the different sources of the observed persistence effect in life cycle employment behaviour. Moreover, we have seen that when these models test the hypothesis of wage exogeneity they do reject it.

This brings us to another source of the observed nonseparability in the life cycle labour supply behaviour: nonseparable lifetime budget constraint. In Section 3.1.3, we have surveyed models which introduce nonseparability of the lifetime budget constraint by relaxing the assumption of wage exogeneity. We have analysed their main results and discussed the distortions that may arise in estimating the effect of different policies on labour supply if one does not relax the intertemporal separability assumption of the lifetime budget constraint.

On the basis of the evidence surveyed in Section 3.1.3, we expect that by introducing past work experience in the wage equation (as we will do in the model presented in Chapter 4) we will get a more continuous work profile for married women over their life cycle. We also expect that child status variables will have a lower discouraging effect than in models which neglect past work experience. A positive impact of past work experience on current wages and through this on current employment probability is also foreseen. Moreover, the empirical evidence surveyed shows that while nonseparable preferences are not found when aggregate shocks are included in the labour supply model, the effect of past work experience on wages and through them on current employment remains also when aggregate shock are included. The analysis carried out in Section 3.1.3 let us be optimistic on the effect on estimation of introducing in our dynamic model of labour supply only a limited amount of information on past work-experience, as we are also forced to do by the data used in the second part of the thesis.

Turning to fixed costs of working we have found that there is only a limited evidence on the introduction of them in a dynamic setting. However, on the basis of the estimated static models with fixed costs and of the theoretical considerations discussed in Section 3.2, we can expect the following:

- an ambiguous effect of additional education on fixed costs of working;
- higher fixed costs of working connected to the child-birth for women who are just entering the labour force;
- an ambiguous long-run effect on fixed costs of childbirth;
- fixed money costs increase hours of work for women already working in the labour market, also in future periods. On the other hand there is an ambiguous effect of fixed time costs on hours of work for working women, according to the simple dynamic model of labour supply with fixed costs of working described in Section 3.2.2.

The evidence surveyed so far has shown how the Frisch Demand models which do not relax the assumptions of intertemporal separability of the lifetime utility function and of the lifetime budget constraint explain only a small variation of prime aged men's labour supply over their life cycle. On the other hand, they seem to perform better in the analysis of married women's labour supply behaviour over the life cycle. Married women are characterized by a higher variation of employment over their life cycle and the estimated intertemporal elasticity of substitution is higher than for males, showing that they are more responsive to wage changes than men are. This facts, together with the evidence on the change in married women's work profile over their life cycle which has occurred in recent decades, would bring us to choose to investigate female labour supply in a dynamic setting by using a framework similar to the Frisch demand model outlined in Chapter 2.

However, the evidence surveyed in this Chapter has shown how persistence effect arises also for female labour supply, and how the model outlined in Chapter 2, because of its strong assumptions, cannot explain this behaviour. We have seen that one can modify this model, in order to account for the persistence effect in employment, either by relaxing the intertemporal separability assumption of the lifetime utility function or by relaxing the assumption of separability of the lifetime budget constraint. Given the vast literature suggesting that wage rates for women are endogenous and are affected in large part by their intermittent labour supply and by their expectations concerning childrearing, we choose to relax the wage exogeneity assumption and by this way the assumption of intertemporal separability of the lifetime budget constraint in the model that we will present in the following Chapter. We have followed this route also on the light of the results surveyed in this Chapter showing the robustness of the past work experience effect to unobserved heterogeneity (Eckstein and Wolpin, 1989) and to aggregate shocks (Altug and Miller, 1991), and the rejection of the habit persistence effect in models which endogenize wages (like the one of Eckstein and Wolpin, 1989). Moreover, the evidence on fixed costs of working surveyed in Section 3.2, leads us to analyse their effect in the dynamic model presented in Chapter 4.

CH.4 - A WAGE-EXPERIENCE DYNAMIC MODEL OF FEMALE LABOUR SUPPLY

Introduction

The changes which have occurred in married women's labour supply, both in the level of participation rates and in their life cycle employment behaviour, outlined in Chapter 1 lead us to be particularly interested in analysing the labour supply behaviour of this component of the population in a dynamic setting.

The dynamic model that we present in this Chapter is similar in its structure to the Frisch demand model (that we have described in Chapter 2) used by Heckman and MaCurdy (1980, 1982) in their analysis of female labour supply and by MaCurdy (1981) on male labour supply. As we have discussed in the previous Chapters, this model seems to perform better when it is applied to the analysis of female labour supply over the life cycle (which shows a greater variation and also a higher intertemporal elasticity of substitution) than when applied to the analysis of male labour supply. However, we have chosen to modify the theoretical structure of the model surveyed in Chapter 2, by relaxing one of its strong assumptions: the assumption of intertemporal separability of the lifetime budget constraint.

The evidence surveyed in Chapter 3 rejects one of the implications of the assumption of intertemporal separability of the lifetime budget constraint: the lack of persistence effect in employment. However, the persistence effect in employment behaviour can arise because of a variety of reasons, including nonseparable preferences, unobserved heterogeneity and

nonseparable lifetime budget constraint.

We have chosen to introduce wage endogeneity, and by this way to relax the assumption of separability of the lifetime budget constraint, because of the vast evidence on the importance of past work experience on women's current wages. Moreover, we have seen how the positive state dependence induced by the the past work experience effect on wages is robust to unobserved heterogeneity (Eckstein and Wolpin, 1989) and to aggregate shocks (Altug and Miller, 1991). We have also seen that the habit persistence effect (which would lead to nonseparable preferences) is rejected in a dynamic model of female participation which endogeneizes wages (the one by Eckstein and Wolpin, 1989).

Our dynamic model of female labour supply is presented in Section 1. The main aim of this first application is to show how the Frisch demand for leisure differs if we break the intertemporal separability assumption of the lifetime budget constraint by introducing past work experience in the wage equation. The reasons of introducing past work experience in the wage equation are human capital accumulation and seniority. One can assume the existence of learning-by-doing human capital and include past work experience as a form of accumulated human capital in the wage equation, or one can correlate higher wages to higher seniority in the labour market.

In the previous Chapter we have shown the importance of fixed costs of working on labour supply in a static and in a dynamic setting. In Section 3.2.2, we have seen the implications of introducing fixed costs of working in a dynamic model of labour supply which maintains the assumptions of intertemporal separability of the lifetime utility function and of the lifetime budget constraint. In Section 4.2 we carry out some comparative

dynamics exercises to analyse the effect of introducing fixed costs of working in our dynamic model of labour supply which endogenizes wages.

The results of the estimation of this dynamic model on female labour supply to British and to German data are discussed in Ch.8 and 9 in Part 2, where also the assumptions that we will follow in the econometric application of the model described here will be discussed (Section 6.4). In Section 4.3, we compare our theoretical model to other dynamic models on labour supply with particular attention to those surveyed in Section 3.1.3 which relax the assumption of intertemporal separability of the lifetime budget constraint, and we summarize the main results of this Chapter.

SECTION 4.1 - A DYNAMIC MODEL OF LABOUR SUPPLY WITH ENDOGENOUS WAGES

4.1.1 - The Model

One source of the persistence effect in the individual's employment behaviour is the existence of nonseparable preferences. We can account for them either by including a term in past work experience directly in the instantaneous utility function, as we do in equation (1.a) below, or by using a more general functional form for the utility function similar to the one used by Mankiw, Rotemberg and Summers (1985) which is additive separable only if $\xi=0$ (equation 1.c).

However, as we have specified in the Introduction to this Chapter, we will not allow for nonseparable preferences in the application of our model to the analysis of married women's labour supply and therefore we will adopt the utility function (1.b) which is similar to the functional form chosen by Heckman and MaCurdy (1982).

$$(1.a) \quad U_{1t} = \phi_1 A_{1t} \left\{ \frac{L_{1t}^\alpha - 1}{\alpha} \right\} + \phi_2 B_{1t} \left\{ \frac{C_{1t}^\mu - 1}{\mu} \right\} \\ + \phi_3 L_{1,t-1} K_{1,t-1}$$

$$(1.b) \quad U_{1t} = \phi_1 A_{1t} \left\{ \frac{L_{1t}^\alpha - 1}{\alpha} \right\} + \phi_2 B_{1t} \left\{ \frac{C_{1t}^\mu - 1}{\mu} \right\}$$

$$(1.c) \quad U_{1t} = [1/(1-\xi)] \cdot \left[\phi_1 A_{1t} \left\{ \frac{L_{1t}^\alpha - 1}{\alpha} \right\} + \phi_2 B_{1t} \left\{ \frac{C_{1t}^\mu - 1}{\mu} \right\} \right]^{(1-\xi)}$$

$A_{it} = \exp [\Omega_{it} a + \varepsilon_{it}]$ where
 Ω_{it} = observed factors affecting leisure
 ε_{it} = unobserved factors affecting leisure
 B_{it} = observed factors affecting Consumption
 i_{it} = dummy = 1 if woman i works at time t ,
 = 0 otherwise
 $K_{i,t-1}$ = past work experience of woman i

If $\phi_3 = 0$ in (1.a) one gets equation (1.b) where one excludes nonseparable preferences from the model.

The chosen functional form implies that the utility function is within period additively separable in consumption and leisure (C and L), i.e. that: $(\partial^2 U / \partial C \partial L) = 0$. We are aware of the existence of tests which reject the hypothesis of within period separability of the utility function.¹ However, as discussed in Section 2.3, given the chosen functional forms, if one relaxes the assumption of within period separability and requires Frisch demands with marginal utility of wealth (or a function of it) that appears additively, one would have to assume homotheticity of preferences, which has undesirable implications (like unitary within period full-income elasticities).

One reason for choosing the functional form (1.b) for the utility function is that it will lead to identify its structural parameters in the empirical application. The intertemporal substitution elasticity from (1.b) is: $[1/(\alpha-1)]$. Strict concavity of the utility function (1) requires that $\alpha < 1$.

The lifetime utility function for equation (1.b) is equation (2):

¹ For instance Hotz et al. (1988) reject within period separability.

$$(2) \sum_{t=0}^T \frac{1}{(1 + \rho)^t} \left[\phi_1 A_{1t} \left\{ \frac{L_{1t}^\alpha - 1}{\alpha} \right\} + \phi_2 B_{1t} \left\{ \frac{C_{1t}^\mu - 1}{\mu} \right\} \right]$$

Instead of relaxing the assumption of intertemporal separability of the lifetime utility function, we relax the assumption of intertemporal separability of the lifetime budget constraint by imposing the following wage equation:

$$(3) W_{1t} = \exp(\beta_1 + \beta_2 K_{1,t-1} + \beta_3 EDUC_{1,t} + \beta_4 EDUC_{1,t} K_{1,t-1} + \varepsilon_{2,1,t})$$

$$(4) K_{1,t} = h_{1,t} + k \Phi_{1,t} \\ = (T - L_{1,t}) + k[(T - L_{1,t-1}) + (1-\delta)(T - L_{1,t-2})]$$

T = maximum amount of hours available for allocation between L and h

$h_{1,t}$ = current hours of work $\Phi_{1,t}$ = human capital accumulated at $t-1$

$EDUC_{1,t}$ = level of education (years of schooling),

δ is the depreciation rate of the accumulated work experience.

In the estimated model we assume that the current level of education is equal to the next period expected level of education: $EDUC_{1,t} = EDUC_{t+1}^e = EDUC_1$. In this specification we do not account for training in the firm or in specialized centres since we do not possess data on them.

$K_{1,t}$ is the human capital accumulated at time t and we only go back two periods. We do so for two reasons. On one hand the evidence surveyed in the previous Chapter shows that only recent past work experience matters. On the other hand we are also limited by the amount of information available in the data used in Part II on lagged employment.

We introduce past work experience in the right hand side of the wage equation (3) because of two different reasons (justified also by empirical evidence):

1) past-work experience can be considered as a form of accumulated human capital (learning-by-doing);

2) seniority: people with higher seniority in the labour market have higher wages.

The other explanatory variables included in the wage equation are: years of schooling as a form of human capital different from on the job training, and an interaction term between education and past work experience ($EDUC_i K_{i,t-1}$). The latter has been introduced under the assumption that schooling can have a positive effect on the work-experience human capital: highly educated women are expected to enjoy higher returns from past work experience in terms of wages.

Equation (5) below is the budget constraint, where $Z_{i,t-1}$ are household's assets at $t-1$; P_t =goods prices at t ; and $S_{T+1}=0$ and $S_0=Z_0$ are the terminal and initial conditions.

$$(5) \quad S_{i,t} = Z_{i,t-1}(1+r)^{-t-1} + \sum_{t=1}^{T-1} (1+r)^{-t} [W_{i,t}(T-L_{i,t}) - P_t C_{i,t} - \sum_j F_{i,t,j} N_{i,t,j} - b_{i,t}] \geq 0$$

We assume also that fixed costs enter the budget constraint. $F_{i,t,j}$ are the goods cost per child of age j (say childcare facility costs) that the woman has to bear at time t if she works (i.e. if $L_{i,t}$ is equal to one) and $N_{i,t,j}$ are the number of children in age group j for woman i at time t . Also b are fixed costs of working but they are not related to the presence of young children in the family and they are assumed to be constant (example: commuting costs). In the simplified version of the model estimated in PART II, we assume that both $F_{i,t,j}$ and b are equal to zero, i.e. we exclude Fixed costs from the budget constraint, given the lack of information in the data set used.

We apply to the optimal problem the maximum principle approach, with L and C as control variables and assets, human capital, education, number and age of children and wage (the profile of which will vary according to the work profile in this case because of its endogeneity) as the state variables.

$$(6) \quad H_t = f_t + \lambda_t S_t + \gamma_t Q_t$$

H = Hamiltonian

f = utility function, objective function to be maximized equation (1.b)

S = budget constraint = equation (5)

Q = equation (4) on human capital

γ_t = marginal value to the woman of an additional unit of work-experience
human capital

λ_t = marginal value of net worth

We can get the Maximum Principle or Optimality Conditions (7.1 and 7.2) for the problem, the multiplier equations (7.3, 7.6), and the state equations (7.4, 7.5), assuming that ϕ_1 and ϕ_2 are equal to one.

$$(7.1) \quad \frac{\partial H_{1,t}}{\partial L_{1,t}} = (1+\rho)^{-t} A_{1,t} L_{1,t}^{\alpha-1} - \lambda_{1,t} (1+r)^{-t} W_{1,t} + E_t \gamma_{1,t+1} K_{1,t} - E_t \gamma_{1,t+2} K_{1,t} (1-\delta) \geq 0$$

$$(7.2) \quad \frac{\partial H_{1,t}}{\partial C_{1,t}} = (1+\rho)^{-t} B_{1,t} C_{1,t}^{\mu-1} - \lambda_{1,t} (1+r)^{-t} P_t = 0$$

$$(7.3) \quad \frac{\partial H_{1,t}}{\partial S_{1,t}} = E_t \lambda_{1,t+1} (1+r)^{-t-1} = \lambda_{1,t} (1+r)^{-t}$$

$$(7.4) \quad \frac{\partial H_t}{\partial \lambda_t} = S_t \geq 0$$

$$(7.5) \quad \frac{\partial H_t}{\partial \gamma_t} = K_{t-1} - (T - L_{t-1}) - \delta \bar{\phi}_{1,t-1} = 0$$

$$(7.6) \quad \frac{\partial H_t}{\partial K_{t-1}} = \lambda_{1,t} (1+r)^{-t} (\beta_2 + \beta_4 \text{EDUC}_{1,t}) W_{1,t} (T - L_{1,t}) + \gamma_{1,t} = 0$$

The FOC for leisure implied by a more general utility function like 1.c, if $\xi \neq 0$, and assuming that ϕ_1 and ϕ_2 are equal to one, will differ from equation 7.1, and will be:

$$\begin{aligned} \frac{\partial H_{1t}}{\partial L_{1t}} &= (1+\rho)^{-t} \cdot A_{1t} L_{1t}^{\alpha-1} \cdot \\ &\cdot \left[A_{1t} \left\{ \frac{L_{1t}^{\alpha} - 1}{\alpha} \right\} + B_{1t} \left\{ \frac{C_{1t}^{\mu} - 1}{\mu} \right\} \right]^{-\xi} \\ &- \lambda_{1,t} (1+r)^{-t} W_{1,t} + E_t \gamma_{1,t+1} K_{1,t} + E_t \gamma_{1,t+2} K_{1,t} (1-\delta) \geq 0 \end{aligned}$$

We then solve 7.6 for γ_t . We also assume that $\delta = 1$, this implies that only last period past work experience matters. By doing so we obtain:

$$\gamma_{1,t} = -\lambda_{1,t} (1+r)^{-t} (\beta_2 + \beta_4 \text{EDUC}_{1,t}) W_{1,t} (T - L_{1,t})$$

By substituting for γ_t and γ_{t+1} in 7.1 we obtain:

$$7.1' (1+\rho)^{-t} A_{1,t} L_{1,t}^{\alpha-1} - \lambda_{1,t} (1+r)^{-t} W_{1,t} \\ - k [\lambda_{1,t+1}^e (1+r)^{-t-1} (\beta_2 + \beta_4 EDUC_{1,t+1}^e) W_{1,t+1}^e (T - L_{1,t+1}^e)] \geq 0$$

$$\lambda_{1,t+s}^e (1+r)^{-t-s} = \phi_{1,t+s}^e (1+\rho)^{-t-s}$$

Where $\phi_{1,t+s}^e$ is the marginal value of net worth at time $t+s$ for the individual i .

From equation 7.3 we have that:

$$\lambda_{1,t+1}^e (1+r)^{-t-1} = \lambda_{1,t+2}^e (1+r)^{-t-2} = \dots = \lambda_{1,t}^e (1+r)^{-t}$$

We can write the following Euler Equation:

$$7.1'' A_{1,t} L_{1,t}^{\alpha-1} = \phi_{1,t} W_{1,t} \\ + \phi_{1,t+1}^e (1+\rho)^{t+1} (\beta_2 + \beta_4 EDUC_{1,t+1}^e) W_{1,t+1}^e \{T - L_{1,t+1}^e\}$$

We can then write the Frisch demands for leisure and consumption as in equations 8 and 9.

$$L_{1,t} =$$

$$\{(\phi_{1,t} / A_{1,t}) [W_{1,t} + (\beta_2 + \beta_4 EDUC_{1,t+1}^e) W_{1,t+1}^e (T - L_{1,t+1}^e)]\}^{(1/(\alpha-1))} \quad (8)$$

$$C_{i,t} = \left\{ \frac{\vartheta_{i,t} P_t}{B_{i,t}} \right\}^{\frac{1}{\mu-1}} \quad (9)$$

By imposing $P_t = 1$, and by solving equation (9) for $\vartheta_{i,t}$, we get:

$$\vartheta_{i,t} = B_{i,t} C_{i,t}^{\mu-1}$$

in logarithm:

$$\log \vartheta_{i,t} = \log B_{i,t} + (\mu-1) \log C_{i,t}$$

By rewriting (8) in logarithms, and by dropping the subscript t from EDUC (under the assumption that current level of education equals the next period expected level of education: $EDUC_{i,t} = EDUC_{t+1}^e = EDUC_i$),² we can write equation (8'):

$$(8') \log L_{i,t} = \frac{1}{\alpha-1} \left\{ \log(\vartheta_{i,t} [W_{i,t} + (\beta_2 + \beta_4 EDUC_i) W_{i,t+1}^e (T - L_{i,t+1}^e)]) - \log A_{i,t} \right\}$$

By substituting the expression on $\vartheta_{i,t}$ in (8') we get:

$$(8'') \log L_{i,t} = (1/(\alpha-1)) \{ (\mu-1) \log C_{i,t} + \log B_{i,t} + \log [W_{i,t} + (\beta_2 + \beta_4 EDUC_i) W_{i,t+1}^e (T - L_{i,t+1}^e)] - \Omega_{i,t} \alpha - \varepsilon_{i,t} \}$$

where Ω = observed factors affecting leisure

² This assumption seems quite reasonable when one can assume that the individuals in the sample have completed formal education. This applies to the samples of married women that we draw for the estimation of this model and that we describe in Chapter 6.

We introduce uncertainty in the model with people having rational expectations on forward terms in wages and hours of work, based on the information set available at t . In the empirical application of our model we have to simplify it, by assuming perfect certainty and point expectations, in order to get a simple structural form to be estimated.

$$W_{t+1} = W_{t+1}^e + \Lambda_1 + \varepsilon_1$$

where W_{t+1} is the actual value, W_{t+1}^e the expected value of wages, Λ_1 is the forecasting error and ε_1 the random error.

Equation (8'') is the key equation of our model and it is the demand for leisure equation that we will estimate in Part II. Differently from the model by MaCurdy (1981) surveyed in Chapter 2, we do not require first differencing in order to eliminate the marginal utility of wealth term in the leisure equation, as long as data on consumption (which, given equation (9), allows us to substitute the marginal utility of wealth term) are available.

It is interesting to compare equation (8'') to the standard Frisch Demand for leisure equation derived from the model described in Chapter 2 (where, differently from our model, one does not relax the assumption of the intertemporal separability of the lifetime budget constraint). Under a general functional form for the utility function, the latter will be:

$$L_t = L[\lambda_t P_t, \lambda_t W_t] \quad \text{Frisch demand for leisure in the Model described in Chapter 2.}$$

Differently from the traditional Frisch demand for leisure, in equation (8'') we have forward terms in wages and leisure which, as we have shown in this Section, arise from the type of wage equation that we have chosen. In fact in the wage function (equation 3) we relax the wage exogeneity assumption by entering past work experience in the right hand side and in so doing we relax the assumption of intertemporal

separability of the budget constraint.

The implications of our model for the current employment decision are dramatic. In fact, according to equation (8''), in allocating time between market work and non market activities women consider also the effect that an additional hour of work at time t has on their future wages given that they decide to work in the future. The wage-experience equation of our model implies a positive state dependence which leads to a persistence effect in employment neglected by the standard model presented in Chapter 2. One should notice that the employment persistence effect (with forward terms entering the labour supply equation) found occurs without having imposed nonseparable preferences in the utility function. This is in line with the result obtained by Shaw (1989). In Section 4.3 we compare our model to the other models which endogeneize wages.

4.1.2 - An Euler Equation Approach

Instead of estimating (8'') which in the case of this model can be exactly identified, we can estimate the Euler Equations for the model.

$$\mathcal{L} = \sum (1+\rho)^{-t} U(L_{1,t}, C_{1,t}) + \lambda_{1,t} (S_{1,t}) \quad (I)$$

Where equation (I) is the Lagrangean for the problem of dynamic optimization. S_t is the budget constraint (5) where we have substituted in the wage equation (3) with past work experience as independent variable.

The Euler Equations are:

$$\begin{aligned} \text{II.a } \frac{\partial \mathcal{L}}{\partial L_{1,t}} &= (1+\rho)^{-t} U_L(t) - \lambda_{1,t} (1+r)^{-t} W_{1,t} \\ &+ \lambda_{1,t+1}^e (1+r)^{-t-1} (T - L_{1,t+1}^e) (\beta_2 + \beta_4 \text{EDUC}_{1,t}) = 0 \end{aligned}$$

$$\text{II.b } \frac{\partial \mathcal{L}_t}{\partial C_{1,t}} = (1+\rho)^{-t} U_C(t) - \lambda_{1,t} (1+r)^{-t} P_t = 0$$

$$\text{II.c } \frac{\partial \mathcal{L}_t}{\partial S_t} = E_t \lambda_{1,t+1}^e (1+r)^{-t-1} = \lambda_{1,t} (1+r)^{-t}$$

We can assume that:

$$\lambda_{1,t+1} = \lambda_{1,t} (1+r) \exp \varepsilon_{1,t+1} \quad \text{III}'$$

where $\varepsilon_{1,t+1}$ is an innovation at $t+1$. By expressing III' in log:

$$\log \lambda_{1,t+1} = \log \lambda_{1,t} + \log(1+r) + \varepsilon_{1,t+1} \quad \text{III}''$$

By working out the derivatives in II with the Utility function (1) used above we get:

$$\begin{aligned} \text{IV.a } \{ & (1+\rho)^{-t} A_{1,t} L_{1,t}^{\alpha-1} - \lambda_{1,t} (1+r)^{-t} W_{1,t} + \\ & + \lambda_{1,t+1}^e (1+r)^{-t-1} (T - L_{1,t+1}^e) (\beta_2 + \beta_4 \text{EDUC}_{1,t}) \} = 0 \end{aligned}$$

$$\text{IV.b } \{ (1+\rho)^{-t} B_{1,t} C_{1,t}^{\mu-1} - \lambda_{1,t} (1+r)^{-t} P_t \} = 0$$

By writing IV.b in logarithms, we get:

$$\begin{aligned} \text{IV.b' } \{ & -t \log(1+\rho) + \log B_{1,t} + (\mu-1) \log C_{1,t} \} = \log \lambda_{1,t} - t \log(1+r) \\ & + \log P_t \end{aligned}$$

However, because of the presence of past work experience in the wage equation, it is not possible to obtain a similar expression for leisure. In IV.b' $\log \lambda_{1,t}$ enters linearly. So we can substitute $\log \lambda_{1,t}$ in IV.b' from III'' and if we use first differences, $\varepsilon_{1,t+1}$ enters the demand for Consumption as an error term and we can estimate μ by using the Euler equation for Consumption. Given the difficulties mentioned above we prefer to use the maximum principle approach to get Frisch Demand for leisure. As we did by getting equation 8''.

Section 4.2 - COMPARATIVE DYNAMICS

Wage endogeneity with only learning by doing has already been considered by Weiss (1972). We have extended his model by considering also the impact of other factors on the wage equation (amongst which education and the interaction of it with the acquisition of skills on the job) and by giving to the wage equation and to the human capital accumulation a specific functional form, as analysed in Section 4.1.

Another topic object of this model is the impact of fixed costs on the lifetime budget constraint and therefore on female labour supply in a dynamic setting. In this model the decision concerning fertility are taken as given.

The optimal control problem faced by a woman can be formalized as follows in the discrete case:

$$(1) \text{ Max } (1+\rho)^{-t} \sum_{t=0}^T U_t(h_{i,t}, K_{i,t-1}, C_{i,t}, N_{t,i,j}, EDUC_i)$$

She has to maximize over time a lifetime utility function $f(U_t)$, where the single period utility function is assumed to be strictly concave, and we assume away imperfect capital markets. The arguments of the single utility functions are: hours of work at time t ($h_{i,t}$); past work experience (K_{t-1}); current consumption of market goods (C_t); number of children of age j at time t ($N_{t,j}$) and years of schooling ($EDUC$).

Notice that by allowing K_{t-1} to enter directly the utility function, one relaxes the assumption of intertemporal separability of the lifetime utility function. In this Section we analyse the generalized version of the model presented in Section 4.1 allowing for state dependence coming indirectly via the budget constraint and directly into the utility function. But we relax the latter type of state dependence when we carry out some comparative dynamics exercises.

For each period $U_L < 0$ (disutility of work), $U_{LL} < 0$, $U_C > 0$

and $U_{cc} < 0$.

In her lifetime utility maximization the woman is constrained by a given wage equation (equation 2 below); and by the lifetime budget constraint (equation 3 below), a specific function for the work-experience human capital is also given (equation 4) where β measures the importance of all past work experience in determining the actual human capital stock acquired on the job, and δ is the depreciation rate of the accumulated work-experience.

$$(2) \quad w_{1,t} = \exp (\alpha_1 + \alpha_2 K_{1,t-1} + \alpha_3 K_{1,t-1}^2 + \alpha_4 EDUC_1 + \alpha_5 R_1 K_{1,t-1} + \dots + \varepsilon_{1,1,t})$$

where R is a dummy variable equal to one if the woman has more than average years of education (say more than 13 years of education) and α_5 measures the joint effect of R and on the job training on wages and the dots stand for other terms in past work experience :

$$(3) \quad Z_{1,t-1}(1+r)^{-t-1} + \sum_{t=0}^T (1+r)^{-t} [W_{1,t} h_{1,t} - P_t C_{1,t} - \sum_j F_{1,t,j} D_{1,t} E_t(N_{1,t,j})] \geq 0$$

$$(4) \quad K_{1,t} = h_{1,t} + \beta \phi_{1,t}$$

where:

$$\phi_{1,t} = (1-\delta) \phi_{1,t-1} + h_{1,t-1} = \sum_{s=0}^T (1-\delta)^{s-1} h_{1,t-s}$$

and

$S_{T+1} = 0$ and $S_0 = Z_0$ are the terminal and initial conditions.

$F_{1,t,j}$ are the fixed costs incurred by the woman when she has a baby of age j at t ,¹ D_t is a dummy for participation $D_{1,t} = g(h_{1,t}) = 1$ if

¹ In this model we assume that the child care cost incurred by a woman does not change according to women's work experience. One can assume that given to search costs the cost for child incurred by a woman who enters in the labour market at time t is higher than the cost incurred

$h_{1,t} > b_{1,t}(IF_{1,t})$ where h_t are the reservation hours.

We then apply to the optimal problem the maximum principle approach. In this case the control variables are h (which enters the problem both directly into the utility equation and indirectly through the wage equation and the difference equation for K_t) and C , while assets, human capital, education, number and age of children and wage (the profile of which will vary according to the work profile in this case because of its endogeneity) are the state variables.

The Hamiltonian for the problem is:

$$(5) H_t = f_t + \lambda_t S_t + \gamma_t Q_t$$

where f_t is the objective function to be maximized, S_t are the net assets, Q_t stands for the constraint (4).

γ_t is the marginal value to the woman of an additional unit of work-experience human capital, while λ_t is the marginal value of net worth.

$$\vartheta_t = \lambda_t [(1 + \rho) / (1 + r)]^t$$

ϑ_t as defined above is the marginal value of net worth at period t . Equations (6.a) and (6.b) below give the Maximum Principle or Optimality conditions for the problem, equations (6.c) and (6.d) are the multiplier equations and equations (6.e) and (6.f) are the state equations for the model.²

$$(6.a) \partial H_t / \partial h_t = \partial f_t / \partial h_t + \lambda_t (\partial S_t / \partial h_t) + E_t \gamma_{t+1} (\partial Q_{t+1} / \partial h_t) + \\ + E_t \gamma_{t+2} (\partial Q_{t+2} / \partial h_t) + \dots \geq 0$$

$$(6.b) \partial H_t / \partial C_t = \partial f_t / \partial C_t + \lambda_t (\partial S_t / \partial C_t) = 0$$

$$(6.c) \partial H_t / \partial S_t = E_t \lambda_{t+1} (1+r)^{-t-1} = \lambda_t (1+r)^{-t}$$

$$(6.d) \partial H_t / \partial K_{t-1} = \partial f_t / \partial K_{t-1} + \lambda_t (\partial S_t / \partial K_{t-1}) + \gamma_t (\partial Q_t / \partial K_{t-1}) = 0$$

by a woman who is already in the labour market and does not need to search for childcare facilities.

² In the following equations we have dropped the subscript i .

$$(6.e) \partial H_t / \partial \lambda_t = S_t \geq 0$$

$$(6.f) \partial H_t / \partial \gamma_t = K_{t-1} - h_{t-1} - \beta \phi_{t-1} = 0$$

Where, given the functional forms assumed one gets the following equations:

$$(7.a) \partial H_t / \partial h_t = U_{h_t} (1+\rho)^{-t} + \lambda_t (1+r)^{-t} W_t +$$

$$- \lambda_t (1+r)^{-t} F_{tN_{i,t}} g'(h_t) - E_t \sum_{s=1}^T (1-\delta)^{s-1} \gamma_{t+s} \geq 0$$

$$(7.b) \partial H_t / \partial C_t = U_{C_t} (1+\rho)^{-t} - \lambda_t (1+r)^{-t} P_t = 0$$

$$(7.c) \partial H_t / \partial S_t = \lambda_{t+1} = (1+r) \lambda_t$$

$$(7.d) \partial H_t / \partial K_{t-1} = U_{K_{t-1}} (1+\rho)^{-t} +$$

$$+ \lambda_t (1+r)^{-t} (\alpha_2 + 2\alpha_3 K_{t-1} + \alpha_5 R_t) W_t h_t + \gamma_t = 0$$

Equation (7.d) can be solved for γ_t to get:

$$\gamma_t = - U_{K_{t-1}}^t (1+\rho)^{-t} - \lambda_t (1+r)^{-t} (\alpha_2 + 2\alpha_3 K_{t-1} + \alpha_5 R_t) W_t h_t$$

and:

$$\gamma_{t+1} = - U_{K_t}^{t+1} (1+\rho)^{-t-1} - \lambda_{t+1} (1+r)^{-t-1} (\alpha_2 + 2\alpha_3 K_t + \alpha_5 R_{t+1}) W_{t+1} h_{t+1}$$

Note that (7.c) uses the assumption of perfect certainty according to this assumption the expected value for λ_{t+1} at time t is equal to the point expectation $E_t \lambda_{t+1} \equiv \lambda_{t+1}$. This assumption allows us to get γ_{t+1} simply by using equation (7.d). By substituting γ_t and γ_{t+1} in 7.a one gets:

$$(7.a)' U_{h_t} (1+\rho)^{-t} + \lambda_t (1+r)^{-t} W_t - \lambda_t (1+r)^{-t} F_t N_{1,t} g'(h_t) +$$

$$+ \sum_{s=1}^T (1-\delta)^{s-1} \{ U_{K_t}^{t+s} (1+\rho)^{-t-s} +$$

$$+ \lambda_{t+s} (1+r)^{-t-s} (\alpha_2 + 2\alpha_3 K_{t+s-1} + \alpha_5 R_{t+s}) W_{t+s} h_{t+s} \} \geq 0$$

where

$$\lambda_{t+s} (1+r)^{-t-s} = \vartheta_{t+s} (1+\rho)^{-(t+s)}$$

By dropping the inequality and by collecting terms one gets:

$$(8.a) U_{h_t} = - \vartheta_t [W_t - F_t N_{1,t} g'(h_t)] +$$

$$- \sum_{s=1}^T \vartheta_{t+s} (1+\rho)^s (\alpha_2 + 2\alpha_3 K_{t+s-1} + \alpha_5 R_{t+s}) W_{t+s} h_{t+s} (1-\delta)^{s-1} +$$

$$- \sum_{s=1}^T (1-\delta)^{s-1} U_{K_t}^{t+s} (1+\rho)^s$$

$$\text{equation (7.d)} \Rightarrow \lambda_{t+1} (1+r)^{-t-1} + \lambda_{t+2} (1+r)^{-t-2} + \dots = \lambda_t (1+r)^{-t}$$

$$\text{equation (7.b)} \Rightarrow (8.b) U_{C_t} = \vartheta_t P_t \Rightarrow \vartheta_t = U_{C_t} / P_t$$

By using equation (7.d) and by assuming away direct state dependence in the utility function (i.e. by assuming that $U_{K_t}^{t+s}=0$)

equation (8.a) reduces to:

$$(8.a)'' U_h = - \vartheta_t \left\{ W_t - F_t N_{1,t} g'(h_t) + \right.$$

$$\left. + \left[\sum_{s=1}^T (\alpha_2 + 2\alpha_3 K_{t+s-1} + \alpha_5 R_{t+s}) W_{t+s} h_{t+s} (1-\delta)^{s-1} \right] \right\}$$

Equation (8.a)" reduces to the standard first order condition when:

$g'(h_t) = 0$ or $F_t = 0$; and if $\delta = 1$; and $\alpha_5 = 0$.

Under the assumptions that $g'(h_t) = 1$ (i.e. the woman works in the labour market at t), $F_t \neq 0$ (i.e. women bear fixed costs of entry when they have a child of age i), $0 < \delta < 1$ and $\alpha_5 \neq 0$ we get equation (8.a)" and by inversion of equations (8.a)" and (8.b) we get the following Frisch demands for hours of work and consumption:

$$(9) \quad h_t = h(\phi_t \dot{w}_t, \phi_t P_t, \phi_t F_t)$$

$$(10) \quad C_t = C(\phi_t \dot{w}_t, \phi_t P_t, \phi_t F_t)$$

where:

$$\dot{w}_t = w_t + \sum_{s=1}^T (\partial S_{t+s} / \partial K_t) \quad \text{adjusted wage}$$

Equations (9) and (10) differ from the standard Frisch demands surveyed in Chapter 2, because the latter neglect fixed costs of working and the persistence effect induced by a nonseparable lifetime budget constraint.

Comparative Dynamics

By totally differentiating the Maximum Principle Equations and by normalizing with respect to prices one gets:

$$(11) \quad [U_{hh} + \phi_t (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}] dh_t + U_{hc} dC = -\phi_t dW_t + \\ + [\phi_t N_{1,t} g'(h_t)] dF_t + \\ - [W_t + \sum_{s=1}^T (\alpha_2 + 2\alpha_3 K_{t+s-1} + \alpha_5 R_{t+s}) W_{t+s} h_{t+s} (1-\delta)^{s-1} + \\ + F_t N_{1,t} g'(h_t)] d\phi_t$$

$$(12) \quad U_{ch} db_t + U_{cc} dC_t = d\phi_t$$

$$\Delta(t) = \begin{vmatrix} U_{hh} + \phi_t (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1} & U_{hc} \\ U_{ch} & U_{cc} \end{vmatrix} =$$

$$= U_{cc} \{ U_{hh} + \theta_t (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1} \} - U_{LC}^2 > 0$$

iff

$$U_{hh} U_{cc} - U_{hc}^2 > | U_{cc} U_c (\alpha_2 + 2\alpha_3 K_t) |$$

(-) (+) (+)

where from (8.b) $\theta_t = U_c / P_t$ and by normalizing with respect to prices:

$$\theta_t = U_c$$

By concavity of the instantaneous utility function:

$$U_{hh} U_{cc} - U_{hc}^2 > 0$$

So the condition for $\Delta(t)$ to be positive requires that:

$$U_{hh} - (U_{hc}^2 / U_{cc}) < U_c (\alpha_2 + 2\alpha_3 K_t)$$

Sufficient conditions for maximization

Sufficient conditions can be found by relying on the Arrow's generalized Mangasarian's theorem where:

$$H^0 = \max_{h_t, C_t} H(t, h_t, K_{t-1}, C_t, N_{1,t}, \gamma, \lambda)$$

$$= f[t, K_{t-1}, U_t(\dots)] + \lambda S[t, K_{t-1}, U_t(\dots)] + \gamma Q[t, K_{t-1}, U_t(\dots)]$$

H^0 is the value of the Hamiltonian (H) evaluated at the maximizing h_t and C_t .

The assumption of concavity of f , S and Q in their argument (state and control variables) is replaced by the weaker condition that the maximized Hamiltonian is concave in the State variables (K_{t-1} , and S_t) and the necessary and sufficient conditions for concavity of H^0 is that:

$$\begin{vmatrix} \frac{\partial^2 H^0}{\partial S^2} & \frac{\partial^2 H^0}{\partial S \partial K_{t-1}} \\ \frac{\partial^2 H^0}{\partial S \partial K_{t-1}} & \frac{\partial^2 H^0}{\partial K_{t-1}^2} \end{vmatrix} = \begin{vmatrix} 0 & 0 \\ 0 & \frac{\partial^2 H^0}{\partial K_{t-1}^2} \end{vmatrix}$$

Is negative semidefinite.

If this condition holds equations 8.a-8.b, 7.c, 7.d and 7.e are sufficient conditions for absolute maximization.

From (7.c) one gets that:

$$\frac{\partial^2 H^0}{\partial S^2} = 0 = \frac{\partial^2 H^0}{\partial S \partial K_{t-1}}$$

From (7.d):

$$\begin{aligned} \frac{\partial^2 H^0}{\partial K_{t-1}^2} &= U_{K_{t-1}} (1+\rho)^{-t} + \lambda_t (1+r)^{-t} \{ [(2\alpha_3 + \alpha_2 + 2\alpha_3 K_{t-1} + \alpha_5 R_t) W_t h_t] + \\ &+ [(\alpha_2 + 2\alpha_3 K_{t-1} + \alpha_5 R_t) W_t (\partial h_t / \partial K_{t-1})] \} \end{aligned}$$

When α_5 is equal to zero, if $U_K = 0$, the concavity of H^0 requires:

$$\begin{aligned} (13) \quad & \lambda_t (1+r)^{-t} \{ [(2\alpha_3 + \alpha_2 + 2\alpha_3 K_{t-1}) W_t h_t] + \\ & + [(\alpha_2 + 2\alpha_3 K_{t-1}) W_t (\partial h_t / \partial K_{t-1})] \} = \\ & = \lambda_t (1+r)^{-t} \{ [(\partial^2 W_t / \partial K_{t-1}^2) h_t] + [(\partial W_t / \partial K_{t-1}) (\partial h_t / \partial K_{t-1})] \} < 0 \end{aligned}$$

In fact:

$$\begin{aligned} \partial W_t / \partial K_{t-1} &= (\alpha_2 + 2\alpha_3 K_{t-1}) W_t \\ \partial^2 W_t / \partial K_{t-1}^2 &= (2\alpha_3 + \alpha_2 + 2\alpha_3 K_{t-1}) W_t \end{aligned}$$

By differentiating the optimality conditions 8.a" with respect to

h_t and K_{t-1} one gets (with $\delta = 1$):

$$(14) \quad [U_{hh} + \partial_t (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}] dh_t + \partial_t [(\alpha_2 + 2\alpha_3 K_{t-1}) W_t] dK_{t-1} = 0$$



$$(15) \frac{dh_t}{dK_{t-1}} = - \frac{\theta_t [(\alpha_2 + 2\alpha_3 K_{t-1}) W_t]}{U_{hh} + \theta_t (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}}$$

This term differs from what Weiss (1972) gets for his continuous problem of optimal control because of the forward term in wages and hours of work that are in the denominator of equation (15).

From 8.b with normalization with respect to prices one gets:

$U_c = \theta_t$ and by substituting this into (15) one gets:

$$(16) \frac{dh_t}{dK_{t-1}} = - \frac{U_c [(\alpha_2 + 2\alpha_3 K_{t-1}) W_t]}{U_{hh} + U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}}$$

that is positive as long as $U_{hh} > U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}$

By substituting (16) into (13) one gets:

$$(17) h_t \frac{\partial^2 W_t}{\partial K_{t-1}^2} - (\partial W_t / \partial K_{t-1}) \frac{U_c [(\alpha_2 + 2\alpha_3 K_{t-1}) W_t]}{U_{hh} + U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}} < 0$$

$$(18) h_t \frac{\partial^2 W_t}{\partial K_{t-1}^2} - (\partial W_t / \partial K_{t-1})^2 \frac{U_c}{U_{hh} + U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}} < 0$$

This condition reduces to the one obtained by Weiss (1972) in the continuous case iff:

$$g'(h_t) = 0 \text{ and } \sum_{s=1}^T (1-\delta)^{s-1} \gamma_{t+s} \geq 0$$

In that case from 7.a one gets:

$$U_{h_t} \geq - \theta_t W_t$$

and substituting in it $U_c = \theta_t$ (obtained by (7.b) with price normalization) one gets:

$$U_{h_t} \geq - U_{c_t} W_t$$

And then one can write condition (18) in a simplified way:

$$(19) \quad h_t \frac{\partial^2 W_t}{\partial K_{t-1}^2} + (\partial W_t / \partial K_{t-1})^2 \frac{U_{hh} / W_t}{U_{hh} - (U_h / W_t)(\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}} < 0$$

(-)
(-)
(+)

Where with $\partial^2 W_t / \partial K_{t-1}^2 < 0$ for (19) to hold when past work experience has a positive effect on current work experience³ it is necessary that:

$$h_t \frac{\partial^2 W_t}{\partial K_{t-1}^2} > (\partial W_t / \partial K_{t-1})^2 \frac{U_{hh} / W_t}{U_{hh} - (U_h / W_t)(\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}}$$

By multiplying equation (17) by U_{hh} , and K_{t-1} , and by dividing it by $U_h (\partial W_t / \partial K_{t-1})$ one gets:

$$(20.a) \quad [(U_{hh} / U_h) h_t] \{ (\partial^2 W_t / K_{t-1}^2) K_{t-1} [1 / (\partial W_t / \partial K_{t-1})] \} + \\ - (\partial W_t / \partial K_{t-1}) (K_{t-1} / U_h) \{ U_c / [U_{hh} + U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}] \} U_{hh} < 0$$

Again this condition reduces to Weiss (1972) (11) condition if the standard maximum principle condition

$$U_h \geq - U_c W_t$$

holds and if h_t does not enter the wage equation in period (t+1).

In that case one can rewrite (20.a) as follows:

³ This is the case when $U_{hh} > U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}$

$$(20.b) \{ (U_{hh} / U_h) h_t \} \{ (\partial^2 W_t / \partial K_{t-1}^2) [K_{t-1} / (\partial W_t / \partial K_{t-1})] \} + \\ + (\partial W_t / \partial K_{t-1}) (K_{t-1} / W_t) < 0$$

Where, as in Weiss' condition (11), one can recognize the following elasticities:

$$(1) \text{ elasticity of the marginal disutility of work } = [(U_{hh} / U_h) h_t]$$

which is positive.

$$(2) \text{ elasticity of the marginal productivity of work-experience:$$

$$(\partial^2 W_t / \partial K_{t-1}^2) [K_{t-1} / (\partial W_t / \partial K_{t-1})] < 0$$

$$\text{iff } (\partial^2 W_t / \partial K_{t-1}^2) < 0 \text{ and } (\partial W_t / \partial K_{t-1}) > 0$$

as it is assumed by Weiss (1972)

$$(3) \text{ elasticity of wages with respect to past work experience:$$

$$(\partial W_t / \partial K_{t-1}) (K_{t-1} / W_t) > 0$$

Condition (20.b) above implies, as in Weiss (1972), that the marginal gain from additional work-experience is decreasing.

As Weiss (1972) proved the existence of this condition rules out cycles in the optimal trajectory.

However in the model introduced in this section:

$$- (\partial W_t / \partial K_{t-1}) (K_{t-1} / U_h) \{ U_c / [U_{hh} + U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}] \} U_{hh} = \\ = (\partial W_t / \partial K_{t-1}) \frac{1}{T} \\ \{ K_{t-1} / [W_t + \sum_{s=1}^T (\alpha_2 + 2\alpha_3 K_{t+s-1} + \alpha_5 R_{t+s}) W_{t+s} h_{t+s} (1-\delta)^{s-1} + \\ - F_{t,t+1} N_{t+1} g'(h_t)] \} U_{hh} / [U_{hh} + U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}] = \varepsilon_{W, K_{t-1}}$$

$$\text{iff } g'(h_t) = 0 \quad \delta = 1 \text{ and } [(\partial W_{t+1} / \partial K_t) (\partial K_t / \partial h_t) = 0]$$

But in general:

$$\begin{aligned}
 & - (\partial W_t / \partial K_{t-1}) (K_{t-1} / U_h) \{ U_c / [U_{hh} + U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}] \} U_{hh} = \\
 & = \varepsilon_{W_t, K_{t-1}} \{ W_t / [W_t + \sum_{s=1}^T (\alpha_2 + 2\alpha_3 K_{t+s-1} + \alpha_5 R_{t+s}) W_{t+s} h_{t+s} (1-\delta)^{s-1} + \\
 & - F_{t,t,1} g'(h_t)] \} U_{hh} / [U_{hh} + U_c (\alpha_2 + 2\alpha_3 K_t) W_{t+1} h_{t+1}] > 0
 \end{aligned}$$

$$\text{iff } \sum_{s=1}^T (\partial W_{t+s} / \partial K_{t+s-1}) > F_{t,t,1} g'(h_t)$$

The necessary and sufficient condition for concavity of H^0 can then be written in the general case as:

$$\begin{aligned}
 (20.c) & [(U_{hh} / U_h) h_t] \{ (\partial^2 W_t / K_{t-1}^2) [K_{t-1} / (\partial W_t / \partial K_{t-1})] \} + \\
 & + \varepsilon_{W_t, K_{t-1}} \{ (W_t / U_{hh}) / [W_t + \sum_{s=1}^T (\partial W_{t+s} / \partial K_{t+s-1}) + \\
 & - F_{t,t,1} g'(h_t)] * [U_{hh} + U_c (\partial W_{t+1} / \partial K_{t-1})] \} < 0
 \end{aligned}$$

Which as stated before reduces to the special case analyzed by Weiss (1972) iff the restrictions listed above are imposed to the model.⁴

So condition (20.c) which rules out cycling is not generally satisfied in the model discussed in this section, for this condition to hold one must add the additional requirement that the positive effect of work experience on wages is greater than the fixed costs connected with having a child at age t when the woman decides to enter the labour market [i.e. when $g'(h_t) > 0$].

By turning again to comparative dynamics the solution of the system generated by differentiating the maximum principle necessary conditions implies the following results:

⁴ These conditions are that the standard maximum principle condition $U_{hh} \geq - U_c W_t$ holds and that h_t does not enter the wage equation in period $(t+1)$.

$$(dh_t/dW_t) | (d\theta_t=0) = - (\theta U_{cc} / \Delta_t) > 0 \quad \text{iff } \Delta_t > 0$$

since θ_t is positive and U_{cc} is negative. Δ_t has been defined at page 91.

$$dh_t/d\theta_t =$$

$$= - \{ U_{cc} [W_t + (\sum_{s=1}^T (\partial W_{t+s} / \partial K_{t+s-1}) + F_t N_{t,1} g'(h_t))] + U_{hc} \} / \Delta_t > 0$$

iff $\Delta_t > 0$ and the numerator is lower than zero.

$$d\theta_t/dW_t = - \{ \theta_t / [W_t + (\sum_{s=1}^T (\partial W_{t+s} / \partial K_{t+s-1}) + F_t N_{t,1} g'(h_t))] \} < 0$$

as θ_t is positive and if the denominator is positive.

If one considers both the θ - constant and the θ - variable effects (where θ is the marginal utility of assets) one can decompose the effect of an increase in wage at time t on current labour supply as follows:

$$\frac{dh_t}{dW_t} = \frac{dh_t}{dW_t} \bigg|_{d\theta_t=0} + \frac{dh_t}{d\theta_t} \frac{d\theta_t}{dW_t}$$

Where the first term on the right hand side is the so called θ -constant effect and the second term is the θ -variable effect and by substituting the results obtained above one can write it as follows:

$$\begin{aligned} dh_t/dW_t = & - (\theta_t U_{cc} / \Delta_t) + \\ & + \left\{ \{ U_{cc} [W_t + (\sum_{s=1}^T (\partial W_{t+s} / \partial K_{t+s-1}) + F_t N_{t,1} g'(h_t))] + U_{hc} \} / \Delta_t \right\} \cdot \\ & \{ \theta_t / [W_t + (\sum_{s=1}^T (\partial W_{t+s} / \partial K_{t+s-1}) + F_t N_{t,1} g'(h_t))] \} \end{aligned}$$

The net effect of an increase of wage rate at time t on labour supply at t will be positive if the θ -constant effect dominates.

Differently from the other dynamic models of labour supply where past work-experience does not affect current wages, in the model discussed here the ambiguity in the sign of the effect of an increase in current wages persists also for future labour supply as:

$$\frac{dh_{t+s}}{dW_t} = \frac{dh_{t+s}}{dW_{t+s}} \frac{dW_{t+s}}{dh_t} \Bigg|_{d\theta_{t+s}=0} + \underbrace{\frac{dh_{t+s}}{d\theta_t} \frac{d\theta_t}{dW_t}}_{-} \geq 0$$

The first term in the RHS is the θ -constant effect while the second term on the RHS (the term which is negative in sign) is the θ -variable effect. The net effect will be positive if the θ -constant effect dominates.

Also the effect of fixed costs incurred by the woman with a child aged 1 at time t is ambiguous. Fixed costs of entry in the labour market determine the number of reservation hours for the woman, and, if the desired hours of work are less than the reservation hours she will not enter the labour market. This will make $D_t = 0$ and $g'(h_t) = 0$ so this will rule out a direct effect of fixed costs on the hours of work.⁵ On the basis of the θ -constant effect of fixed costs on hours of work one can then state that a direct effect will occur if and only if $g'(h_t) > 0$, i.e. if she works in the labour market at t (when she will incur the cost related to have a young baby)⁶ and this direct effect will be negative as long as $\Delta_t > 0$. In fact, by solving the system generated by differentiating 8.a" and 8.b one gets:

⁵ If one assumes that $F_{1,t,j}$ are incurred only when the woman decides to enter the labour market and are not incurred by women already working ($h_{t-1} > 0$) a null direct effect occurs also when the woman is already working.

⁶ The model can be extended to include the fixed cost incurred by the woman when a dependent elderly is in the family.

$$\frac{dh_t}{dF_t} \bigg|_{d\theta_t = 0} = \frac{\theta_t N_{1,t} g'(h_t) U_{CC}}{\Delta_t} \leq 0 \quad \begin{cases} < 0 \text{ if } \Delta_t > 0 \\ \text{and } g'(h_t) > 0 \\ = 0 \text{ iff } g'(h_t) = 0 \text{ or } U_{CC} = 0 \end{cases}$$

By considering also the θ -variable effect, with $\Delta_t > 0$ the net effect of the introduction of fixed costs on the hours of work of a woman who works in the labour market is ambiguous.⁷

$$\frac{dh_t}{dF_t} = \frac{dh_t}{dF_t} \bigg|_{d\theta_t = 0} + \frac{dh_t}{d\theta_t} \frac{d\theta_t}{dS_t} \frac{dS_t}{dF_t}$$

+ - -

The first term on the RHS is the θ -constant effect of an increase in fixed costs of working, the last term is the θ -variable effect.

⁷ If we assume that $F_{1,t,j} = 0$ for women showing continuous work-experience (i.e. women who were part of the labour force at least also the previous period) the effect of fixed costs on hours of work will be certainly positive since the θ constant effect equals zero.

Section 4.3 - Conclusions

The model presented in Section 4.1.1 is a Frisch demand model of labour supply where we relax the assumption of intertemporal separability of the lifetime budget constraint. The utility function is assumed to be additively separable over time and within periods, and it is similar to the utility function used by Heckman and MaCurdy (1980, 1982). However, our model differs from the latter given that they do assume both separable preferences and separable budget constraint over time.

Amongst the other models which explicitly relax intertemporal separability of the budget constraint there are the ones by Moffitt (1984b), Shaw (1989), Eckstein and Wolpin (1989) and Altug and Miller (1991). One must stress that the samples and data set considered by those models differ from the ones that we use in Part II to estimate our model. However, here we will devote our attention only to the main theoretical differences between our model and the others referred to above.

Moffitt (1984b) presents a joint labour supply and fertility decisions model and estimates a reduced form approximation of the demand functions that the model generates. On the other hand, we assume fertility to be exogenous and estimate (at least with UK data) the structural form of our model. Moreover, Moffitt introduces in the wage equation also family background variables like parents' education, and a variable to account for secular growth in productivity (year of marriage) but neglects the interaction between schooling and past work experience.

Shaw (1989) in her life cycle model on male labour supply

uses a translog utility function which does not impose within period separability or homotheticity (as instead our utility function does) and contains varying parameters to account for observed heterogeneity in preferences. Moreover, differently from our model, she does not assume that the rental rate of human capital (i.e. the market price of a unit of human capital) is fixed over time and by estimating her model she finds that the rental rate of human capital actually varies from year to year. In order to estimate her model, she uses generalized method of moments and, as Eckstein and Wolpin (1989) pointed out, this method is not applicable when there are corner solutions. So there would be problems in extending Shaw's model to the analysis of female labour supply which shows to be less continuous than male labour supply over the life cycle.

Eckstein and Wolpin (1989) and Altug and Miller (1991) differently from our model, relax both the assumption of intertemporal separability of the lifetime budget constraint and the assumption of intertemporal separability of the lifetime utility function. Moreover, Altug and Miller (1991) introduce the impact of aggregate shocks like changes in overall market conditions in their model, that we neglect.

Eckstein and Wolpin's (1989) model has different arguments in the utility function than our model, and different wage equation and budget constraint. They include participation rather than leisure time in the utility function, and they do not introduce an interaction term in education and past work experience in the wage equation (therefore assuming that schooling does not affect post-school investment in human capital)¹. In their model, Eckstein and Wolpin (1989) introduce in the budget constraint potential annual earnings obtained by multiplying the hourly wage

¹Differently from Eckstein and Wolpin (1989) by estimating our wage equation in Part II we find that the return of past work experience is higher than the return of schooling.

-

rate times 2,000 hours of work, times an employment dummy. In so doing they do not include normal or actual hours of work but assume that each woman in the sample decides about working full-time, and that the wage rate is independent of hours worked. On the other hand, as it will be discussed later, in the application of our model we consider normal hours worked by women and we do not assume that the wage rate is independent of hours worked.

Turning to the theoretical specification of the two models, Eckstein and Wolpin consider simultaneity of fertility and labour supply decisions though they relax this simultaneity in the empirical specification of their model, which is applied only to women in post-fertile ages. They also adopt a specification for fixed costs of working in the budget constraint different from the one that we adopt in Section 4.2. In fact, by adding a multiplicative dummy to the fixed costs term in the budget constraint we consider also corner solutions which Eckstein and Wolpin (1989) neglect. Moreover, in Section 4.2 we concentrate only on the effect of fixed costs of working related to the presence of young children in the family and we do not consider other fixed money costs, differently from what Eckstein and Wolpin do in their theoretical model. However, one should stress that in the empirical specification of both our model and the one by Eckstein and Wolpin (1989) fixed costs of working do not enter the budget constraint.

We will now summarize the main theoretical results of the analysis conducted in this Chapter. The main consequence of including past work experience in the wage equation is that the resulting log leisure equation includes also terms in forward wages and hours of work, as we have analytically shown in Section 4.1.1, and this leads to persistence in employment even if we do not assume nonseparable preferences. We have also discussed an Euler equation approach to our model. However, given the

difficulties (that we have outlined in Section 4.1.2) arisen in applying it to our specification, we prefer to follow the Maximum Principle approach to get an estimable structural form for the demand of leisure (as we have done in Section 4.1.1).

In Section 4.2, we have considered the effect on the labour supply function of extending the model presented in Section 4.1.1 by introducing fixed costs of working related to the presence of children in the family in the budget constraint and by allowing for nonseparable preferences. However, we have relaxed the latter when we carried out some comparative dynamics exercises and discussed the sufficient conditions for maximization.

We have shown how, differently from other dynamic models of labour supply which do not account for past work experience in the wage equation, the ambiguity in the sign of the effect of an increase in current wages persists also for forward labour supply and that also the effect of fixed costs of working connected with the presence of children in the family on women's labour supply is ambiguous.

We will apply the model presented in Section 4.1.1 in Part II to the analysis of U.K. and German married women's labour supply.

PART II

EMPIRICAL ANALYSES ON GREAT BRITAIN AND GERMANY

CHAPTER 5 - FEMALE LABOUR SUPPLY

IN GREAT BRITAIN AND IN WEST GERMANY

INTRODUCTION

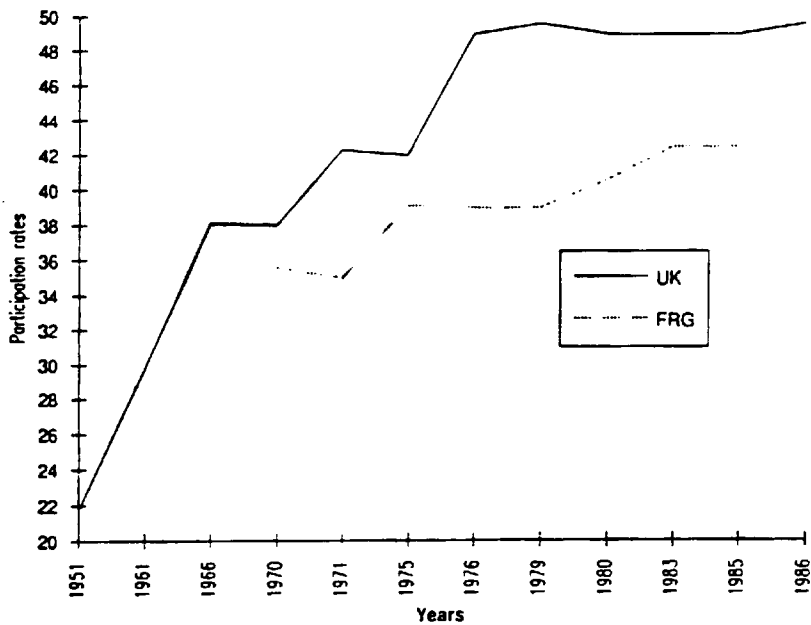
The model presented in Chapter 4 on female labour supply will be applied in this Part to British and West German data. The first Chapter of this Part contains a descriptive analysis of women's labour force participation in the two countries with special attention to the labour supply behaviour of women over their life cycle (Section 5.1). We analyse also the possible institutional factors which can affect female labour supply in the UK and in Germany and how the two countries differ in the type of child care services offered (Section 5.1). Some indicators on occupational and industrial segregation and on the wage differentials by gender are also provided together with an overview of the mechanisms at work in the two countries. Section 5.2 contains a survey on models on female labour supply estimated in the two countries.

Chapter 6 contains a discussion on the different sources of data available for the analysis on female labour supply in the two countries and a descriptive analysis of the sample selected for the estimation of our model. In Chapter 7 we carry out an analysis of earnings mobility in Germany which casts more light on the effect of past work experience in earnings dynamics. The results from the application of the female labour supply model presented in Chapter 4 to British and to German data are to be found in Chapters 8 and 9.

Section 5.1 - Female labour supply in Great Britain and in FRG - a comparative analysis

In both Great Britain and West Germany female labour supply has been increasing in the last decade. Married women aged from 20 to 60 has been the most dynamic component of female labour supply in both countries. As Graph 5.1 below shows married women's participation rates have been increasing in the U.K. since 1951, and married women aged from 20 to 60 years witnessed a continuous increase in their level of participation in FRG (refer also to Tab.5.1 in Appendix I).

Graph 5.1 - Married women's participation rates
U.K. and West Germany - various years *



* Sources:UK - Dept. of Employment Gazette, Dec.1975 - April 1981
Census and Labour Force Survey Data
West Germany: Holst et al. (1988, p.4) from
Statistisches Bundesamt Data

As far as married women's labour supply is concerned, a first difference between the two countries analysed is the level of participation rates which as Tab.5.1 in Appendix I shows is higher in the U.K. than in FRG (in 1986 married women's participation rate was 50% in the UK while the participation rate of West German married women was 42.5% in 1985). This can be imputed to several factors which will be discussed below.

Part-time employment had a significant contribution to the increase in the level of female participation in both countries from 1979 to 1986.¹ However, as Tab.5.2 in Appendix I shows, the contribution to the increase in female employment of part-time working has been higher in the U.K. (7.3%) than in West Germany (2.9%). Moreover the percentage of women in working age (with a child) working part-time in 1988 is higher in the U.K. (70%) than in West Germany (55%). In the U.K., non-married women tend to be concentrated in the 35-40 hours of work per week group. On the other hand, married women (according to the results of the 1986 Labour Force Survey) showed in 1986 a more differentiated pattern of weekly working hours, they also have a higher probability to be found in part-time jobs (see Graph 5.2 in Appendix I). Analyses based on Women and Employment Survey (1980) for the U.K. show that part-time work was chosen by the majority of women after childbearing ages in order to combine work in the labour market with unpaid domestic work and, as Graph 5.3 in the Appendix I shows, the percentage of women with dependent children working part-time is 69% against 39% of those married women without dependent children.²

¹ The increase in part-time employment in FRG has been ascribed to the Laws approved under the Conservative Coalition after 1982 which encourage part-time and to the system of parental leave operating since 1988 which discriminates against women working full-time (the child allowance can be paid only if the parent has no income or if he or she works for less than 20 hours a week). Refer to Vogelheim (1988). A demand side factor that can increase the share of women in part-time employment is that part-time employment can be used by employers in order to avoid the application of Equal Pay Act in the U.K.

² Results from the Department of Employment and Office of Population Censuses and Surveys (1984) and from Marin and Roberts (1984a).

In both countries female unemployment rates were over 9% in 1987 (9.3% in West Germany and 9.6% in the U.K).³ Differently from the U.K. unemployment rates for women are higher than for men in West Germany, as Tab.5.3 in Appendix I shows.

Another factor in common to the two countries is the increase in the level of education of women and a convergence of women and men's level of education over the past 30 years.⁴

Together with an increase in the level of participation, many industrialized countries have witnessed a change in female work profile over their life cycle. Since longitudinal data are available only for a limited number of countries and over a limited time period, cross section data can be used as a partial approximation of this phenomenon. As Graph 5.4 in Appendix I shows in countries like Sweden there has been a tendency of female work profile towards the typical male inverted U pattern, while in FRG and in the UK the typical M shaped workprofiles can still be observed even if at a higher level of participation than in the past. However these data cannot distinguish between cohort and ageing effects. To do so one should use longitudinal data. Cohort data for the UK show how still British women's workprofile is far from being an inverted U (see Graph 5.5 in Appendix I).

By comparing a retrospective Survey for Great Britain (Women and Employment Survey, 1980) and the retrospective analysis for the first wave of the German Socio Economic Panel (year 1984), the OECD (1988) analysis shows how in both countries the two-peaked work-profile is still

³ These figures refer to OECD (1988) standardized unemployment rates (i.e. to those people who are not working and are available to begin to work and who have taken job search steps in a recent period). By adding to these figures also discouraged workers (who are not looking actively for jobs since they believe that jobs are not available) and people not immediately available to start a job, the OECD (1987, 1988) analysis shows how women's unemployment rates will increase more than men's unemployment rates.

⁴ For cohort data on education level by sex refer to the OECD (1989) analysis (OECD, 1989, Tab.2.1 p.54). For a detailed analysis on FRG refer to Blossfeld (1990).

widespread though at higher participation level for both cohorts (see Graph 5.6 in Appendix I). The typical work-profile of British women, as found by the analysis of Dex and Shaw (1986) based on the Women and Employment survey (1980), shows that they generally begin their work experience as full-timers and end up in part-time jobs sooner after their child-births.

Several analyses based on longitudinal data on the U.K.⁵ feature new patterns of work over the life cycle for younger cohorts. They are more likely than older ones to return to work quicker. Moreover, younger cohorts show a shortening in the period of leave for childbearing reasons, or even no withdrawal at all from the labour force during periods of child-bearing. They also show to work between births.⁶

Graph 5.7 in Appendix I shows how the M shaped work-profile is typical in these two countries for mothers, while women without children have a work-profile over their life increasingly similar to the one of men. The analysis of Stewart and Greenhalgh (1984) based on the National Training Survey data confirms this result; in particular they found that never married single women are characterized by a more continuous work profile than married women, and those amongst them who have experienced interrupted work-profile have a shorter outbreak than other women.

As one can see by comparing the British and German women's work profiles the decline and then the recovery in participation rates for mothers is more rapid for British than for West German women. This may be due to institutional factors. The German system of childcare has been found more favorable than the British one for preschool children (Moss, 1990) and this can explain the quicker decline for British than for West German

⁵ For analyses based on longitudinal data refer to Martin and Roberts (1984a), Dex (1984), Dex and Shaw (1986), Stewart and Greenhalgh (1984) and Main (1988a).

⁶ On this phenomenon refer to Martin and Roberts (1984a) and to Martin (1986). They found that the age groups born after the 1930s showed a faster return to paid work than those born before.

mothers' labour supply in their first childrearing years.⁷ However, the organization of the school-day and the compatibility with mothers' working hours is better in Great Britain than in West Germany when the child reaches the primary school age. This can perhaps explain why the participation rates for British women with a child aged less than 5 in 1988 was 37% against 53% for mothers of children aged from 5 to 9 while the respective figures for FRG were 34 and 39%.⁸

In analysing the labour supply behaviour of women with children in pre-primary school age, one has to consider that in the U.K. the system of child care facilities for pre-school children is targetted to "children in need" and priority is not given to children of double workers' families.⁹ The UK, according to a recent OECD (1990) analysis as the USA, is a country characterized by the maximum private responsibility in child-care services in the OECD area. The availability of child-care facilities financed by the State in 1988 for children aged less than 3 years was 2% of all the children in this age group, and of 35-40% for children from 3 to 5 in the UK, while the figures in West Germany for 1987 were respectively 3% and 65 to 70%¹⁰. Moreover the British system of maternal leave is less favourable than in other countries since it can be used only by women who worked more than 2 years full-time or more than 5 years part-time

⁷ For data on the enrolment rates in pre-primary education in year 1986-87 refer to Tab.5.4 in Appendix I to this Chapter.

⁸ Usually the length of a school day in the U.K. is 6 hours and a half and meals are provided at school, while the length of a school day in FRG is 4 to 5 hours and usually they do not provide meals at school. Data referred to by Moss (1990).

⁹ Moss (1990) and OECD (1990).

¹⁰ The second figure for West Germany refers to children aged from 3 to 6-7 years since in West Germany the compulsory age of entry in primary schools is 6-7. In analysing the availability of child care services for pre-school children one has to consider that they differ across each of the 2 countries considered since the organization depends on local authorities and districts (lander). So in FRG 50% of all the places available for pre-school children are concentrated in Berlin and Hamburg. Data from Moss (1990) and OECD (1990).

with the same employer. Moreover there is no system of leave for both the parents in the U.K. and no tax relief on the costs for child-care.¹¹

As Vogelheim's (1988) analysis shows, during the 70's when there was labour shortage, management encouraged married women's labour supply in West Germany by offering day-care facilities within companies, training programmes and part-time. These policies show to be procyclical since in period of economic crisis they decreased quite drastically to come back again during the second half of the 80's when there was labour shortage again.¹²

An element which has a negative effect on married women's labour supply in FRG is the type of tax system. The tax system in FRG is of a split type. The total income liability (TH) is obtained by the following system: the total income of the family (Y), after deduction of basic appropriate allowances (A) and social security contributions (S), is divided by two and the progressive tax schedule (t) is applied to each half.¹³ The German couple can also use a separate system of taxation but income splitting is more usual. As far as we know this system of taxation is peculiar to FRG, while in the U.K. as in most countries the separate system of taxation does not coexist with split but with a joint

¹¹ On the other hand the parental leave has been introduced in FRG in 1986 and applies to parents until the child is 15 months old (18 months since July 1990) the allowance for it is inversely related to the household income, while the maximum duration for maternity leave is of 14 months paid at the mother's wage. In Germany one can also enjoy a tax refund for child-care expenses at home up to 12,000 DM. Data from Moss (1990).

¹² It would be interesting to analyse the change in these policies after the unification and the availability of an increasing number of well qualified East European workers.

¹³ $TH = (2 * t * ((Y - a - S) / 2)) + S$

For a description of the German tax system refer to Strom and Wagenhals (1988).

system of taxation.¹⁴ A new law stimulating tax reduction and relief of families has been passed in West Germany in 1985 (for a description of it refer to Drengel, 1987) and, as Gustafsson (1992) stresses, this new law brings the German tax system more in direction of family dependence and away from individual taxation which has a lower negative impact on married women's labour supply.

Turning to other elements that may affect women's labour force behaviour we notice how in both countries the degree of occupational and industrial segregation is still high and that occupational segregation is increasing in the U.K..¹⁵ As we have mentioned above in both the U.K. and FRG there is a high percentage of women working part-time. In the U.K. part-time jobs have been found (on the basis of the Women and Employment Survey, 1980) to be mainly in female over-represented occupations¹⁶ and to be characterized by lower possibility of career as well as by lower access to job-related benefits.¹⁷ The presence of part-timers in lower status position has been found by Schoer (1987) to be greater in the U.K. than in West Germany.¹⁸

¹⁴ The coexistence of joint and separate taxation can be found also in Italy, while in Sweden separate system of taxation is compulsory since 1974. It would be interesting to analyse the effect of female labour supply of these different systems of taxation in the four countries. Policy simulations conducted on FRG data show how a change towards separate taxation would sensibly increase married women's labour supply, for this refer to Holst et al. (1988), to Strom and Wagenhals (1988) and to Gustafsson (1992). The latter carried out a comparison between the different effects of the Swedish and the German system of taxation on female labour supply.

¹⁵ The index shows higher degree of occupational segregation the finer is the disaggregation by industries or occupations. Refer to Tab.5.3 in Appendix I to this Chapter and to OECD (1988, p.147).

¹⁶ This result has been found by Martin and Roberts (1984c, p.204) and by Ballard (1984, p.411).

¹⁷ Data by Ballard (1984, p.411). The analysis of Elias (1988) based on 1981 Labour Force Survey data, shows that over 1/3 of women working part-time are in low-skill category. Lower pay, according to the results of Ballard (1984, p.413) and of Martin and Roberts (1984c, p.205), is also usually attached to part-time jobs.

In the U.K., as Tab.5.6 in Appendix I shows, there has been an overall increase in employment in the Public Sector during the 1970s, which has then been reversed after 1981 partly because of the privatization of public corporations occurred under Thatcher's administration. By considering the distribution of employed women by industry (Tab.5.7 in Appendix I) one can see how large is the share of women employed in the service sector as compared to other sectors in the U.K. The increasing female concentration in the service sector in the U.K. brought about an increase in the Dissimilarity Index (refer to Appendix II of this Chapter for a description of this index) between 1950 and 1980 (which according to ECE, 1985, data was 18.5 in 1950, 21.0 in 1960, 26 in 1970 and 28 in 1980).

On the other hand in West Germany, the Service Sector is not as expanded as in other industrialized countries and the significant cuts in hiring of the Public Sector in the 70's reduced significantly another component of female employment. This can in part explain the lower degree of industrial segregation for West German women than for British women as shown in Tab.5.5.b (Appendix I).¹⁹

There is also a considerable wage differential by gender in both countries higher in the U.K. (the wage differential by gender in 1986 was 0.729 for FRG and 0.679 in the U.K.)²⁰.

¹⁸ He uses 1983 Labour Force Survey data for the U.K. and the 1982-1983 Mikrozensus data for West Germany.

¹⁹ As Erler (1988) stressed another peculiarity of FRG economy with respect to women's employment is that the West German economy is more export-oriented and that the type of jobs available in industry are more likely to be male jobs. Moreover, as Schmid (1986) outlines there is still a high share of women in Agriculture in FRG.

²⁰ Refer to Tab.5.8 in the Appendix I to this Chapter for data on wage differentials in the two countries since 1955. In the U.K. there has been a decrease in the wage differential by gender from 1973 to 1976 in the same period when the equal pay legislation was implemented. For analyses on the link between equal pay legislation and wage discrimination refer to Snell et al. (1981) and to Zabalza and Tzannatos (1985a, 1985b).

As far as the equal opportunities legislation is concerned, one can notice how the Equal Pay Act has been passed in FRG 10 years later than in the U.K. (where it has been passed in 1970) together with Equal Employment Opportunities Laws.²¹ Moreover up to 1988 there were no affirmative actions required in West Germany and as Vogel-Polsky (1985) pointed out the lack of autonomy of the Directorate on women's affairs (established in FRG in 1970 within the Federal Ministry of Youth, family affairs and health, in order to speed up the process leading to equality between sexes by using positive actions) and its limited financial resources, seriously jeopardize its action.

²¹ Equal Employment Opportunity laws have been implemented in the UK in 1975.

Section 5.2 - EMPIRICAL ANALYSES

ON FEMALE LABOUR SUPPLY IN FRG AND UK

5.2.1 - Analyses of married women's labour supply in West Germany

There are only a few studies on female labour supply in West Germany and most of them are static models of female labour supply.¹ In this section we will summarize the main results of the static models of female labour supply estimated on the basis of West German data and devote particular attention to the only life cycle analysis of female labour supply in FRG that we are aware of: that by Hujer and Schnabel (1990).

In our dynamic model on female labour supply past work experience has a key role as shown in Chapter 4. Turning to the existing empirical evidence on it, the importance of past work experience on current employment probability has been directly stressed by the results of Merz's (1987, 1990) model on female labour supply estimated by using the first wave of the German Socio Economic Panel² and indirectly by Franz's (1985) analysis on participation rates. Franz finds that women with vocational training have higher participation rates. However, the type of vocational training that Franz (1985) considers³ is attended by people who are actually working and so it has to be considered as past work-experience rather than education. Merz (1987, 1990) finds

¹ Also Holst et al. (1988) and Merz (1987) have recognized how the analysis of female labour supply in West Germany is limited.

² For a description of this data set, which we use in Chapter 7 and 9, refer to Chapter 6. Merz estimates a 3 stage labour supply model by estimating: participation probability, market wage and hours of work equations.

³ He refers to apprenticeship training in business administration.

that years of full-time work have a positive effect on married women's labour supply whereas the lower effect of part-time work experience on current labour supply is not significant.⁴

Another factor which enters our model of female labour supply is education. The empirical evidence on the effect of education on married women's labour supply is mixed. The effect of education on married women's labour supply probability has been found not to be significant by Kaiser et al. (1989, p.20) and by Strom and Wagenhals (1988). On the other hand, by distinguishing amongst different types of education, Merz (1990, p.252) finds that women having an intermediate leaving certificate are more likely to be working than others. A positive effect of education on German married women's employment probability has also been found by Micklewright and Giannelli (1991).

Other income in the household has been found to have the expected negative effect on married women's labour supply.⁵

Given the system of taxation in West Germany (described in the previous section) we expect married women's employment rates to be lower in West Germany than in Great Britain. In fact, West Germany has a split type of taxation which has been found to discourage married women's labour supply. A shift from the split type of taxation to a separate type of taxation has been found to increase participation rates of married women by 8.3 percentage

⁴ However his model on labour supply can be criticized on the basis of the endogeneity of many of the right hand side variables (like the individual past work experience variables).

⁵ Refer to Merz's (1987,1990) analysis. He finds that income from interests and dividends does not significantly affect married women's labour supply. Personal transfer payments (such as retirement/widows' pensions and last year unemployment benefit) do significantly reduce the labour supply of married women while housing benefits and any kind of welfare payments do not have a significant effect on married women's labour supply according to Merz's results.

points (from 44.5% to 52.8%) by the analysis of Strom and Wagenhals (1988),⁶ and by 9.7% (from 50.3% to 60%) by Gustafsson's (1992) analysis.⁷

Turning to the effect of the husband's employment status on married women's labour supply, the analyses by Merz (1987,1990) and by Franz and Kawasaki (1981)⁸ show that being married to a self-employed person significantly increases married women's employment probability. Turning to the effect of the presence of an unemployed husband on their wives' labour supply, Kaiser et al. (1989) find that an unemployed husband has a negative effect on married women's labour supply.⁹ The more detailed analysis by Micklewright and Giannelli (1991) shows a discouraging effect of regional unemployment rate and of husbands unemployed and getting unemployment assistance.

As expected in most of the empirical models on female labour supply in West Germany the presence of children aged less than 15

⁶ Strom and Wagenhals (1988) use a sample of 25 to 65 years old married women from the first wave of the German Socio Economic Panel to estimate a static model of labour supply which considers the effect of the change in the type of taxation on married women's participation rates. They consider only households with wage-income and exclude those persons who stated to have worked more than 75 hours in the week preceding the 1984 interview.

⁷ Gustafsson (1992) compares the German 1984 split type of taxation with the Swedish separate system of taxation by using the 1984 first wave of the German Socio-economic Panel and the first wave (1984) of HUS for Sweden.

⁸ This can probably be connected also to the system of taxation. Franz and Kawasaki's (1981) analysis is based on the 1976 microcensus data while the ones by Merz are based on the first wave of the German Socio Economic Panel.

⁹ Merz (1987,1990) does not distinguish in his analysis on female labour supply between unemployed and other people with no earnings, and he finds that the effect of the presence in the household of a husband's not earnings-income is positive on their wife's labour supply probability.

has a discouraging effect on their mothers' labour supply.¹⁰ The analysis by Gustafsson (1992) shows how the negative impact of the presence of children in preschool age for German mothers' labour supply disappears for Swedish mothers. This, as the author stresses, can be explained by the Swedish system of subsidized childcare which is more favourable to working mothers than the West German one.¹¹ Therefore, when comparing the effect of children on mothers' labour supply in Great Britain and in West Germany we will take into account also the different system of child care facilities in the two countries.

Hujer and Schnabel's (1990) analysis is the first dynamic model of female labour supply applied to West German data which we are aware of. Their model maintains the assumption of intertemporal separability of the lifetime utility function, but it includes past work-experience in the labour supply equation (together with education and education squared) in order to predict current wages. They use four waves of the German Socioeconomic Panel (from 1984 to 1987) and they estimate reduced form longitudinal models on a sample of 1,182 German women continuously married to the same husband since 1984 and aged from 16 to 58 in year 1984.

Their choice of a Tobit model and the lack of consideration in the labour supply function of any demand side factor are questionable,¹² but the comparison that they carry out between cross section Tobit model, random and fixed effect Tobit models is

¹⁰ Refer to the analyses by Franz and Kawasaki (1981, p.139) on the 1976 MicroCensus data, Holst et al. (1988, p.37), Kaiser et al. (1989, p.18), Merz (1990), Micklewright and Giannelli (1991), by Strom and Wagenhals (1988), and by Gustafsson (1992).

¹¹ On the Swedish system of childcare facilities refer to Gustafsson and Stafford (1991).

¹² For a critique on the use of Tobit models for the estimation of female labour supply models refer to Mroz (1987).

interesting. By comparing longitudinal and cross section Tobit models estimates they find that cross section results overestimate the non-labour income coefficient and underestimate the effect of children on their mothers' labour supply.

One can criticize Hujer and Schnabel's (1990) model because they do not fully consider the implications of considering past work-experience as predictor of current wages. For instance differently from the model that we have presented in Chapter 4, Hujer and Schnabel do not consider the persistence effect that the accumulated work-experience human capital has on the current leisure equation. Thus they neglect the effect of current employment decision on forward wages and employment probability and this, as discussed in Chapter 3, may produce omitted variables bias. Moreover, it must be stressed that they estimate the model in its reduced form.

Turning to the estimated wage equations we can see how the effect of past work experience on current net hourly wages is found to be significant and positive by Merz (1990) and by Gustafsson (1992) and not significant by Strom and Wagenhals (1988,p.21).¹³

Years of education have a positive and significant effect on the current level of wages as found by the analysis of Strom and Wagenhals (1988).¹⁴ Merz (1990) finds that women with an

¹³ Merz finds that years of full-time work positively affect current wages in his analysis based on retrospective information from the first wave of the German Socio-economic Panel which we describe in more depth in Chapter 6. Gustafsson (1992) finds a positive and significant effect of past work-experience on current wages, a negative significant effect of years of part-time and a negative impact of the split system of taxation on returns to human capital for married women by using the same data set as Merz. In the estimation of their model Strom and Wagenhals (1988) use *potential* work-experience, i.e. years of age minus years of education minus seven.

¹⁴ The return of education on wages of married women is 8% according to Strom and Wagenhals' (1988, p.21) analysis.

intermediate or upper secondary school leaving certificate have a higher current level of market wages than others.¹⁵

The Heckman's λ has the expected positive effect in the wage equation estimated by Merz (1987,1990) but it is not significant, whereas it is significant in the wage equations estimated by Franz and Kawasaki (1981) on 1976 Microcensus data and by Strom and Wagenhals (1988) on the German Socioeconomic Panel.

¹⁵ The analysis of Franz and Kawasaki (1981) which does not consider past work experience as a right hand side variable in the wage equation, finds that only Upper Secondary School (Abitur) has a positive and significant effect on current wages.

5.2.2 - Analyses of married women's labour supply in Great Britain

Most of the econometric models of female labour supply in the U.K. belong to the "first generation" of econometric models of labour supply; they do not consider fixed costs of work and are mainly static models. A new generation of econometric models on female labour supply has been developed which uses more sophisticated specifications than the OLS analysis or Tobit models and explicitly allows for labour demand constraints in the labour supply decision.¹⁶

Past work experience is generally found to have a positive and significant effect on married women's labour supply and on their earnings.¹⁷ Not only the number of years in employment but also the type of work-profile (whether interrupted or not) affects the labour supply decision of married women.¹⁸ Education has also a positive effect on married women's labour supply.¹⁹

¹⁶ Refer to the models of Blundell, Ham and Meghir (1987,1988) and of Arellano and Meghir (1990). They find that demand side variables (like regional unemployment) significantly affect the participation decision and the wage equation of married women.

¹⁷ This result has been found by Joshi et al. (1985) and by Stewart and Greenhalgh's (1984) analysis based on the 1975/6 National Training Survey data (based on a retrospective survey of 50,000 individuals in Great Britain).

¹⁸ On the effect of an interrupted work-profile on occupational attainment and earnings refer to the analysis by Stewart and Greenhalgh (1984, p.504). They found that those who have experienced interruptions in their work-profile are more likely to work part-time and to earn less on average than other women, and that the length of their interruptions increases the above likelihood.

¹⁹ Only Joshi, Layard and Owen (1985) find that the improved educational attainment of women does not play an important role on women's participation.

The effect of other income in the household on married women's labour supply is generally found to be negative and Joshi (1986) finds that married women are more responsive to change in other income in the household than unmarried women.²⁰ On the other hand the husband's occupational status does not have an important effect on married women's labour supply as found by Gomulka and Stern (1986).²¹ Turning to the effect of the presence in the family of an unemployed husband, most of the studies on married women's labour supply in Great Britain support the existence of a discouraged worker effect.²²

Married women's wages have the expected positive and significant effect on their labour supply and outweigh the negative income effect.²³

As the theory on female labour supply predicts, the presence in the family of young children reduces their mothers' labour

²⁰ On average the coefficient of the husband's wage on the married women's labour supply equation is -0.01 and the coefficient of the earnings of other members of the family is -0.02.

²¹ The only exception is when the husband is a teacher, in that case, as found by Gomulka and Stern (1986) the employment probability of their wife increases by ten percent. This may be due to the lower number of working hours of teachers which makes child-care easier for the family.

²² The prevalence of a discouraged worker effect is found both in time series and in cross section analyses on female labour supply in the U.K. Refer, amongst others, to the analyses of: Greenhalgh (1977), Berg and Dalton (1977), McNabb (1977), Grice (1978), Elias (1979), Layard, Barton and Zabalza (1980) and Joshi (1986).

²³ In their analysis based on Family Expenditure Survey data from 1970/71 to 1982/83, Gomulka and Stern (1986) find that the average coefficient of the fitted wage in married women's probability of employment equation is 1.13 and that it is not stable over-time. Greenhalgh (1977) uses Census data of 1971 and the New Earnings Survey for data on wages and finds a higher wage elasticity for women (1.35) while the estimate obtained by Layard, Barton and Zabalza (1980) in their logit model applied to 1974 General Household Survey data is lower (0.5).

supply.²⁴ Gomulka and Stern's (1986, 1990) analysis shows that the presence, more than the precise number, of children under 4 years old discourages married women's labour supply and how this deterrent effect is stable over time from 1970 to 1983. However, when one takes into account demand side factors (like regional unemployment), the size of the deterrent effect of the presence of young children in the family on married women's labour supply is reduced.²⁵

²⁴ Layard, Barton and Zabalza (1980) in their static model on female labour supply find that married women's employment probability and hours of work are reduced by the presence in the family of children under 3 years old, but that their hours of work do not increase with the child's age.

²⁵ For this finding applied to U.K. data refer to the analysis of Blundell, Ham and Meghir (1987).

Section 5.3 - Conclusions

As the descriptive analysis carried out in Section 5.1 clearly shows married women's work-profile significantly differs from the work profile of other women or men in both Great Britain and West Germany. The interrupted work profile, according to the dynamic model that we have presented in Chapter 4 can be one reason for the wage differential by gender still persistent in both countries.

In Section 5.1 we have also analysed those institutional factors which may cause a difference in married women's employment behaviour over their life cycle in the two countries (for instance the different system of child-care services and the availability of part-time work). We will come back on the implications of these factors when we will discuss the results of the estimation of our dynamic model on labour supply for the two countries (Chapter 8 and 9). In particular, on the basis of the different child-care and maternal leave systems in the two countries outlined in Section 5.1, we expect the discouraging effect of the presence of children in pre-school age to be higher on married women's labour supply in Great Britain than in West Germany. On the other hand we expect that the discouraging effect of the presence of children in school age should be higher for West German than for British mothers.

We are not aware of other analyses on Germany and Great Britain which use a dynamic model on labour supply similar to the one that we have presented in Chapter 4. However, the survey of the empirical analyses on German and British female labour supply carried out in Section 5.2, allows us to make some hypotheses on the sign of the effect of the main variables included in our model.

We expect past work experience to have a positive effect both on current employment probability and on current wages. A discouraging effect of unemployed husbands and of young children

on married women's labour supply is also expected on the basis of the evidence provided. The effect of education on current wages is expected to be positive. The particular system of taxation of West Germany let us expect, on the basis of the evidence provided, that married women's labour supply in West Germany would be lower than married women's labour supply in Great Britain.

APPENDIX I

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- TAB.5.3 - Unemployment rates by gender UK and FRG
- TAB.5.4 - Enrolment rates in pre-primary education UK and FRG
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APPENDIX I - TABLES AND GRAPHS TO CHAPTER 5

TAB. 5.1.a - ACTIVITY RATES BY SEX AND MARITAL STATUS

	U.K. 1951 - 1986						
	1951	1961	1966	1971	1976	1979	1986
MEN	89.0	88.6	87.4	85.8	83.8	82.2	80.4
MARRIED WOMEN	21.7	29.7	38.1	42.3	49.0	49.6	49.9
NON-MARRIED W.	56.8	54.5	55.0	51.5	50.4	50.7	51.1

1) sources: Dept. of Employment Gazette, Dec.1975 Tab.5, and April 1981, Tab.4.; Data for 1951, 1961 and 1971 are taken from the Census of Population the other from the Labour Force Surveys.

2) people aged 16 or over are classified as economically active if they had a job or did some paid work in the week before interview, or if they were looking for work in that week.

TAB.5.1.a - Civilian labour force(1) - Population of working age(2) by age- Great Britain 1971 - 1986 millions

	Civilian Labour Force			Population of working age
	males	females	total	
1971	15.6	9.3	24.9	31.7
1976	15.6	10.1	25.7	31.9
1979	15.6	10.4	26.0	32.6
1981	15.6	10.6	26.2	32.9
1983	15.3	10.6	25.9	33.3
1984	15.5	11.0	26.4	33.6
1985	15.5	11.1	26.6	33.7
1986	15.5	11.2	26.7	33.9

(1) Civilian labour force: excludes HM forces, includes those students who are economically active. Estimates for 1971 are based on the Census of Population; those for 1976-1986 on Labour Force Survey results adjusted to a mid-year basis and for the inclusion of non-private houses. Central Statistical Office. Social Trends, 1988 n.18, London HMSO, Source Dept. of Employment

(2) Population aged from 16 to retirement age (60 for women and 65 for men).

TAB.5.1.b - Labour Force Participation rates by marital status and age over time (*) in FRG

	married women				
	age	15-20	20-40	40-60	60+ Total
Years					
1970		57.7	43.3	38.7	12.4 35.6
1975		57.9	50.1	42.1	8.6 39.1
1980		55.2	53.8	43.6	5.6 40.6
1983		52.2	55.4	47.0	6.5 42.5
1985		51.4	57.6	47.4	5.5 42.5

Single females

	age	15-20	20-40	40-60	60+	Total
Years						
1970		53.3	85.7	60.4	21.0	63.1
1975		50.2	79.2	85.5	15.1	57.6
1980		40.9	80.6	84.3	10.0	55.1
1983		38.2	78.6	81.2	10.8	54.2
1985		41.7	81.2	83.1	8.5	58.8

(*) computed from data published by Statistisches Bundesamt
by Holst et al. (1988, p.4)

Tab.5.2 - Incidence of part-time amongst women and its contribution to employment growth. Percentages (°)

	Part-time as a proportion of:					
	Tot.employ.			Female emp.		
	1979	1983	1986	1979	1983	1986
FRG	11.2	12.6	12.9	27.6	30.0	29.8
UK	16.4	19.1	21.6	39.0	42.4	45.0

	Female share of part-time employment		
	1979	1983	1986
FRG	91.6	91.9	90.3
UK	92.8	89.6	88.7

	Contribution to cumulative growth of female emp.79-86		
	Part-time	Full-time	Total
FRG	2.9	-0.6	2.3
UK	7.3	-4.4	2.9

(°) Figures from OECD (1988, p.149)

Tab.5.3 Unemployment rates by gender (°°)										
	1983		1984		1985		1986		1987	
	M	F	M	F	M	F	M	F	M	F
FRG	6.7	9.3	6.8	9.3	6.6	9.5	6.1	9.2	6.3	9.3
UK	11.9	9.8	11.6	10.3	11.8	10.9	11.9	10.9	10.8	9.6
(°°) Figures from OECD (1988)										

Tab.5.1.4 - Enrolment rates in pre-primary education (°°°)				
	AGE: 2	3	4	5
FRG	12.6	38.7	72.3	85.5
UK	1.3	25.0	68.1	-

(°°°) Data from OECD (1990).
 These rates show the number of children attending on a full-time or part-time basis a nursery school, a kinder-garten or other similar establishment (both public and private) in relation to total population at this age. The entry age to elementary school is 5 years in U.K. and 6-7 in FRG.

Tab.5.5.a Dissimilarity indices (a) of male and female by major occupational groups - Percentages(°)					
	1960	1970	1980	1981	1984
FRG	37.5 (36.2)	35.1 (36.0)	36.4 (37.4)	37.7 (37.9)	37.8 (38.1)
UK	- -	42.4 (36.3)	- -	44.4 (39.8)	- -

(°) Figures from OECD (1988)

(a) The index would take the value 0 per cent if, relative to its total size, women's employment were distributed across the major occupational groupings (1-digit level) in a similar fashion to men. It would, theroretically, be 100% if men and women were never found together in the same major groups. Figures in brackets refer to the proportion of women in total employment.

Tab.5.5.b Dissimilarity indices (a) of male and female by major industrial divisions - Percentages(°)								
	1960	1970	1975	1980	1981	1982	1984	1986
FRG	29.8 (37.5)	27.8 (36.6)	29.0 (38.0)	28.8 (38.1)	29.1 (38.3)	29.0 (38.6)	28.7 (38.9)	28.6 (39.1)
UK	29.0 (34.0)	30.6 (36.3)	32.4 (38.7)	33.2 (40.2)	33.5 (40.6)	33.3 (41.0)	32.4 (41.9)	31.3 (42.7)

(°) Figures from OECD (1988)

(a) The index would take the value 0 per cent if, relative to its total size, women's employment were distributed across the major industrial divisions (1-digit level) in a similar fashion to men. It would, theroretically, be 100% if men and women were never found together in the same major divisions. Figures in brackets refer to the proportion of women in total employment.

Tab.5.6 People in employment by sector - UK (millions)

	Public Sector				
	G	P	T	PS	TE
1961	3.7	2.2	5.9	18.6	24.5
1971	4.6	2.0	6.6	17.8	24.4
1976	5.3	2.0	7.3	17.5	24.8
1981	5.3	1.9	7.2	17.2	24.3
1984	5.3	1.6	6.9	17.1	24.1
1985	5.3	1.3	6.6	17.9	24.4
1986	5.3	1.2	6.5	18.0	24.5
1986					
Male	2.3	1.0	3.3	10.9	14.2
Female	3.0	0.2	3.2	7.1	10.3

G= GENERAL GOVERNMENT P=PUBLIC CORPORATIONS T=TOTAL

PS = PRIVATE SECTOR, TE = TOTAL IN EMPLOYMENT

Source: Central Statistical Office.Social Trends 1988, n.18
London HMSO

Tab.5.7.a Employees in employment by industry and sex - UK

	Men			Women		
	A	I	S	A	I	S
1951	6	54	40	2	40	59
1961	5	53	42	1	36	63
1971	4	53	43	1	30	69
1980	4	48	48	1	23	76

A=agriculture, I=Industry, S=Service

Tab.5.7.b The share of women in the total labour force, by major economic sectors. U.K.

	All Sectors	Non-farm sect.	Industry	Services
1961	32.5	33.3	24.3	42.2
1971	36.5	37.1	24.5	47.8
1980	39.1	40.6	23.6	51.5

Tab.5.7.c Share of women in total employment in non-farm sectors. U.K.				
	1959	1968	1974	1980
All non-farm sect.	35	38	41	41
of which:				
Mining, quarrying	3	4	4	5
Manufacturing	32	30	30	29
Electricity gas water	11	14	19	20
Construction	4	6	8	7
Wholesale and retail trade,				
Hotels, restaurant	51	54	56	55
Transport and Communic.	14	16	17	18
Finance, insurance, real				
estate	44	50	51	52
Community, social and				
private service	53	54	58	57

Source: ECE (1985)

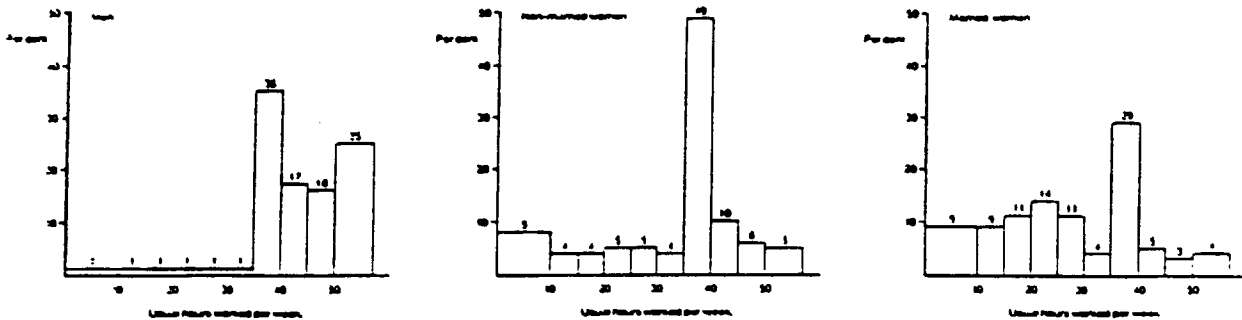
Tab.5.8 Ratios of female to male hourly earnings for manual
workers in manufacturing.

Date	FRG	U.K.
1955	0.628	0.585
1960	0.656	0.573
1970	0.696	0.576
1971	0.701	0.585
1972	0.707	0.593
1973	0.709	0.607
1974	0.716	0.651
1975	0.721	0.665
1976	0.722	0.702
1977	0.723	0.708
1978	0.728	0.691
1979	0.728	0.691
1980	0.727	0.688
1981	0.731	0.688
1982	0.730	0.688
1983	0.726	0.690
1984	0.727	0.688
1985	0.727	0.682
1986	0.729	0.679

Source: OECD (1988, p.212)

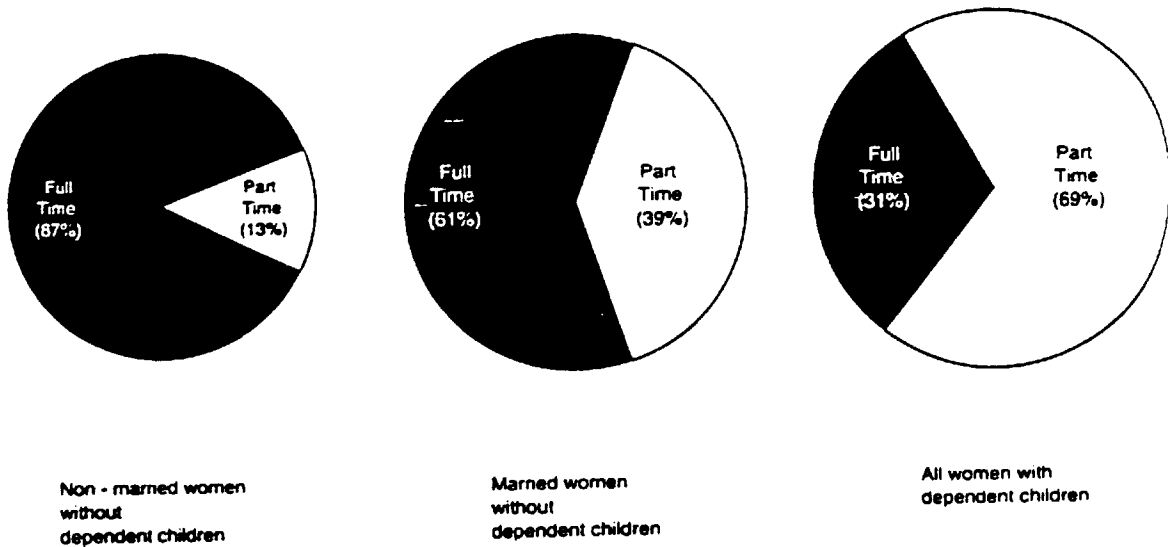
GRAPH 5.2 - Usual hours worked per week for persons aged . 16 or over in employment. Great Britain 1986.

Source: Labour Force Survey 1986. From EOC (1987)



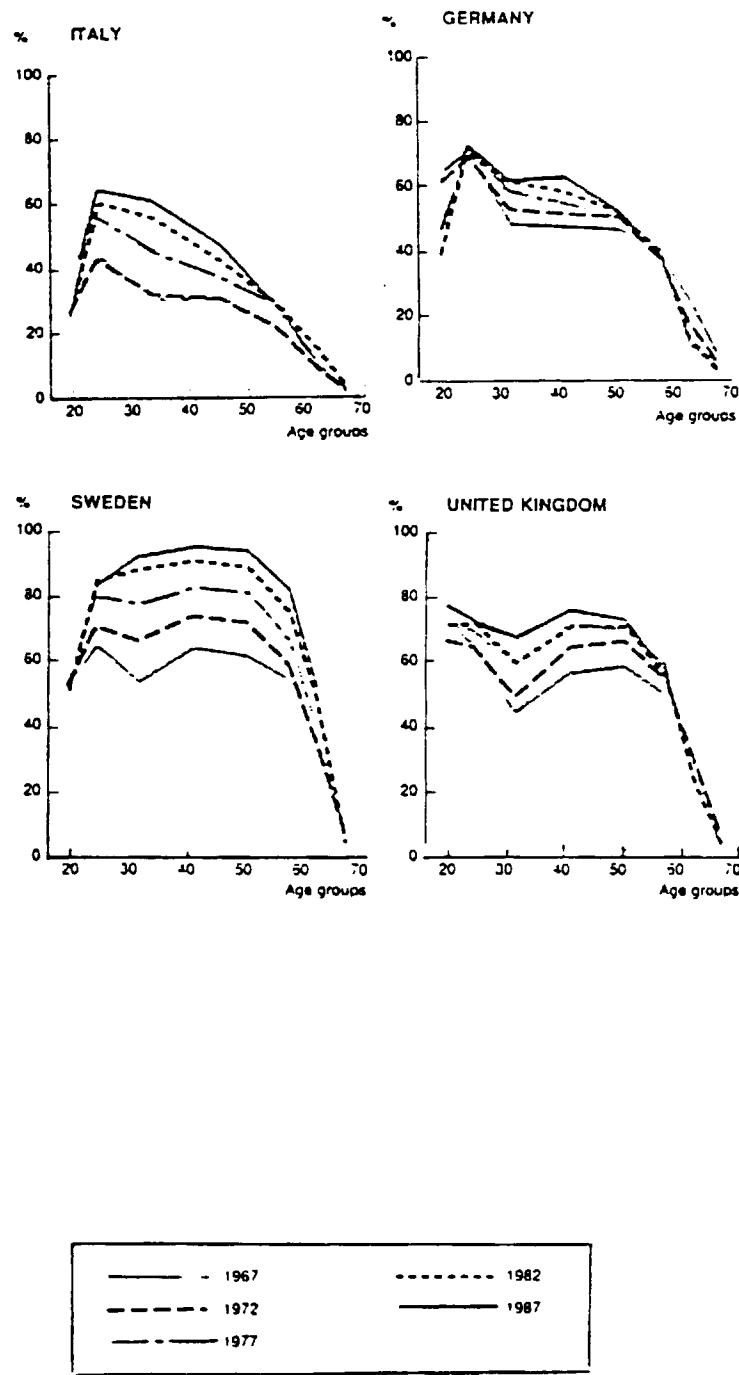
GRAPH 5.3 - Working Women by family status and whether full-time or part-time. Great Britain 1984.

Source: General Household Survey. From: EOC (1987)



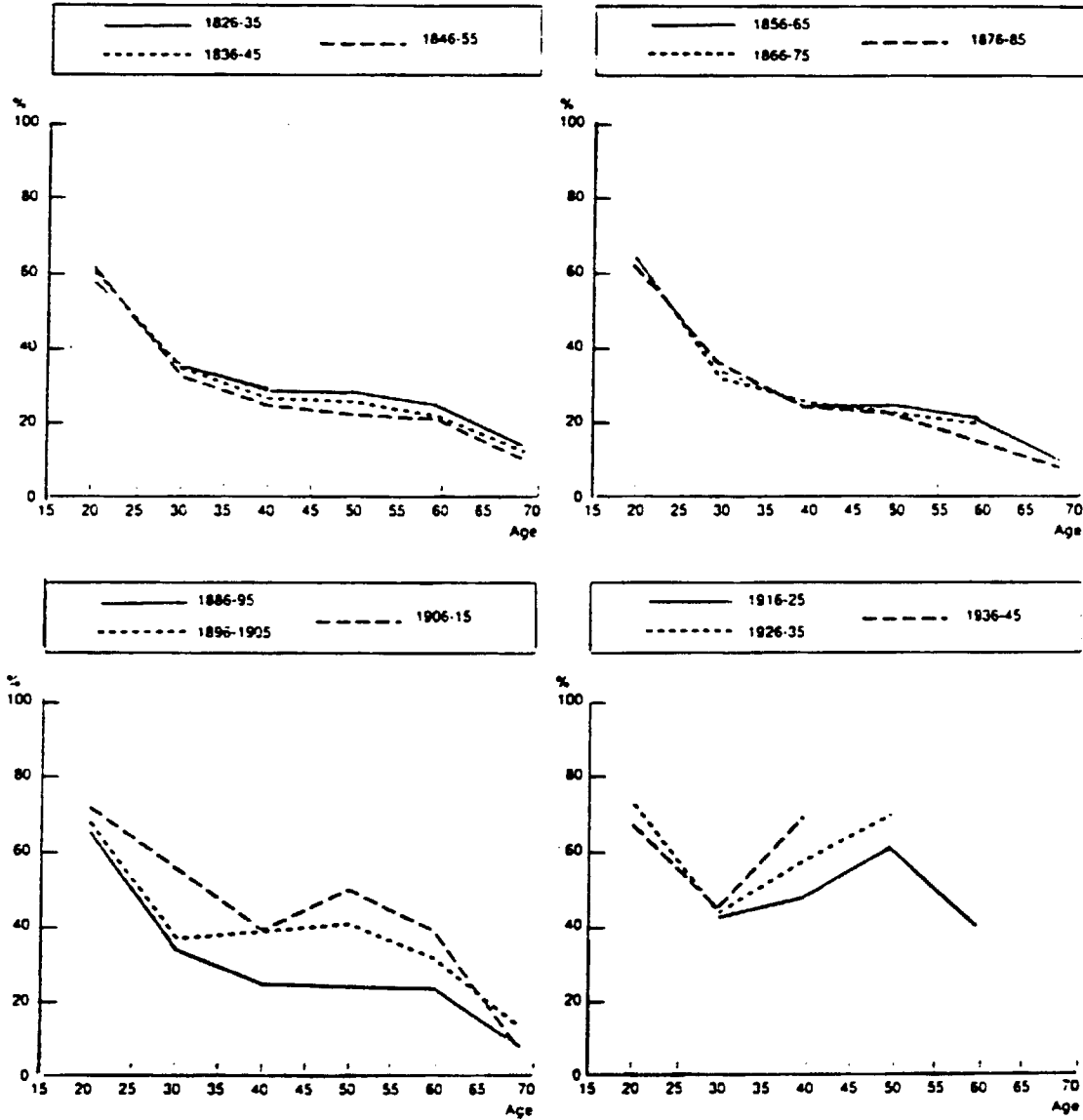
GRAPH 5.4 - Female Synthetic cohort work-profiles
Germany, U.K., Italy and Sweden

Source: OECD (1988) pp.132-133



GRAPH 5.5 - Female Participation Profiles by birth cohorts U.K.

Source: OECD (1988) p.137



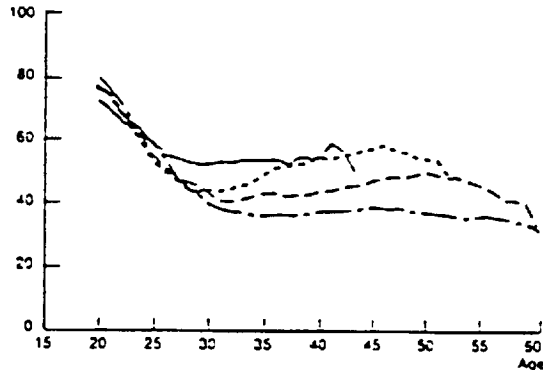
GRAPH 5.6 - Female Participation Profiles by type of work for different birth cohorts **U.K. and Germany**

Source: OECD (1988) p.139

(Percentages)

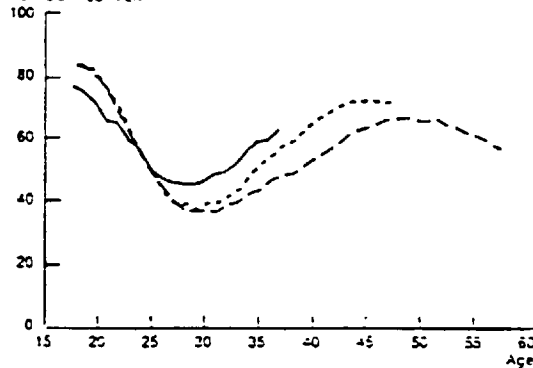
GERMANY*

TOTAL PARTICIPATION

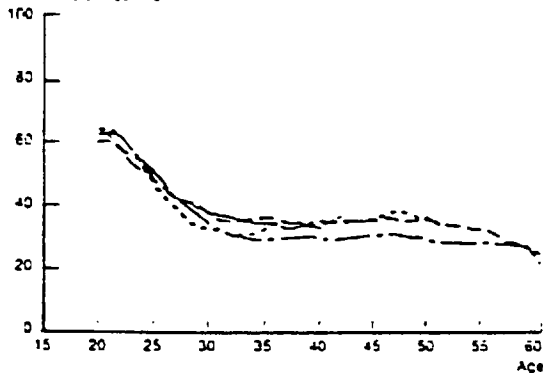


UNITED KINGDOM

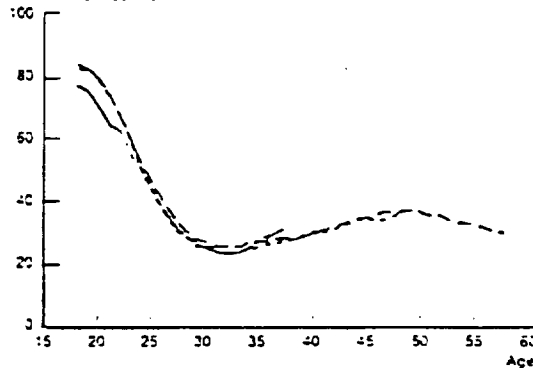
TOTAL EMPLOYMENT



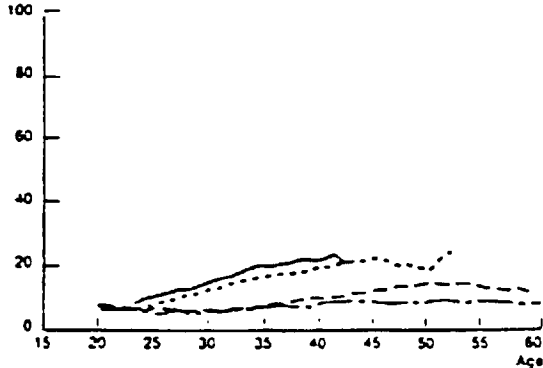
FULL-TIME EMPLOYMENT



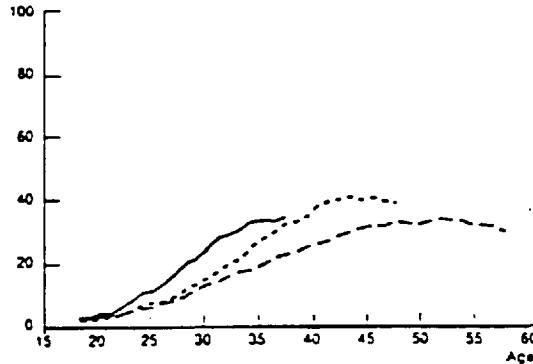
FULL-TIME EMPLOYMENT



PART-TIME AND OCCASIONAL PARTICIPATION

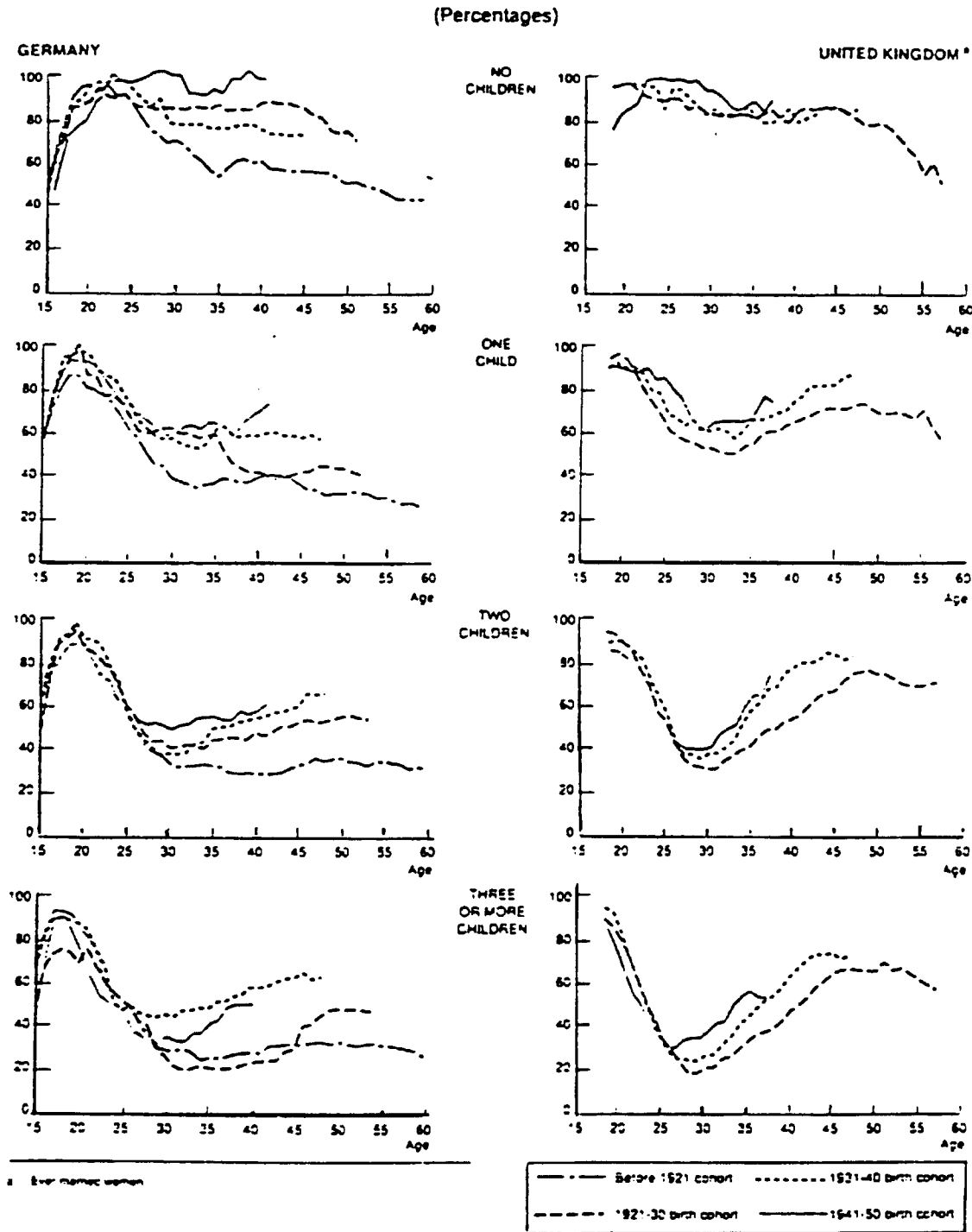


PART-TIME EMPLOYMENT



— Before 1921 cohort - - - 1921-30 birth cohort
 . . . 1931-40 birth cohort — 1941-50 birth cohort

**GRAPH 5.7 - Female Participation Rates by number of children
for different birth cohorts
U.K. and Germany**
Source: OECD (1988) p.141
(percentages)



APPENDIX II

The dissimilarity index (D.I.) is a widely spread index for occupational segregation. It was introduced by Duncan & Duncan (1955a and 1955b) in order to measure residential race segregation. As regards to occupational segregation by gender, it is defined as the absolute sum divided by 2 of the differences between the proportion of the female labour force in a given category and the proportion of the male labour force in that category.

$$D.I. = 1/2 \cdot \sum_j^n | (w_{jt} / w_t) - (m_{jt} / m_t) |$$

where the subscript t refers to a given time, j to a given category, m to men and w to women.

The D.I. ranges from 0 (= perfect integration) to 1 (=complete segregation). A situation of complete segregation arises when each employment category is completely filled either by men or by women. The index can also be expressed in percentage as we do in Tab.5. 5 in Appendix I to this Chapter.

For a discussion of the limits of this index as a measure of gender occupational segregation refer to Jonung (1986).

CHAPTER 6 - DATA USED FOR THE ESTIMATION OF THE DYNAMIC MODEL ON FEMALE LABOUR SUPPLY IN GREAT BRITAIN AND GERMANY

INTRODUCTION

The estimation of our model on life-cycle female labour supply requires data on women's forward and past work-experience and on their forward wages, apart from information on current hours of work, wages, household's characteristics, age, and level of education. The optimal data set for estimating our model is a longitudinal survey containing the above mentioned information.

In this Chapter we discuss the limitations and advantages of the available data sets. In Section 6.1 we compare genuine and pseudo panel data. Section 6.2 contains a description of the data that we use to estimate our dynamic model of British (Section 6.2.1) and German (Section 6.2.3) married women's labour supply. The data set that we use for the U.K. is a cross section enlarged by using cohort proxies of individual variables which allows us to estimate the Structural form of the model presented in Chapter 4 and shows how to estimate a dynamic model on labour supply when individual households' panel data are not available.¹ We describe the approach followed in order to construct the cohort proxies in Section 6.2.2. The data set that we use for the estimation of a quasi-reduced form of our dynamic model on married women's labour supply carried out in Chapter 9, and to investigate wages and earnings mobility by gender in Germany (as we do in Chapter 7) is the German Socio economic Panel.

In Section 6.3 we present some descriptive statistics on the samples drawn from the British data set (Section 6.3.1) and from

¹ A problem that one has to face in the estimation of dynamic models on labour supply in most of the European countries.

the German Socio Economic Panel (Section 6.3.2).

In Section 6.4 we discuss the problems connected to the application of the theoretical model presented in Chapter 4 to the data set described.

SECTION 6.1 - GENUINE AND PSEUDO PANEL DATA

Genuine panel data provide information on the same individual over time. This type of data is therefore useful if one has to estimate a dynamic model, like the one that we have presented in Chapter 4, since it provides individual information on the variables of interest for different periods.

The advantages of panel data for the estimation of life-cycle models are well known:

1) since panel data usually offer a large number of data points the use of panel data can improve efficiency of the econometric estimates and reduce estimation bias. Panel data lessen the problem of multicollinearity in fact, as Hsiao (1985) stresses: panel data offer many more degrees of freedom as well as information on individual characteristics, and therefore the gap between information required to test a model and information provided by the data is notably reduced.

2) Panel data, by providing sequential observations for a number of individuals allow one to distinguish inter-individuals differences from intra-individuals differences and therefore allow the identification of economic models via the reconstruction of a recursive structure with "before and after" effects and allow direct analysis of individual dynamic processes. Given their structure panel data provide useful information to test for "state dependence" or "population heterogeneity". More in general, as Blundell and Meghir (1990) stress, the advantage of panel data in the estimation of life-cycle models is that panel data allow the estimation of life-cycle models at the same level on which theory

is formulated and they do not suffer from aggregation bias.²

However, panel data present also some disadvantages that the literature (refer to Hsiao, 1986, Chamberlain, 1984 and Blundell and Meghir, 1990) has well stressed. Amongst the disadvantages of panel data a serious one is the attrition rate: some individuals may drop from the sample and if this happens randomly there may be a loss of information and efficiency, if this happens non-randomly (or endogenously) the panel can lose its representativeness. Moreover panel data are generally available only for short periods for most of the European countries and this can generate problems of estimation of dynamic models requiring more waves or large sample size. If the panel is short, .

the asymptotic arguments rest on the limiting behaviour of the estimators as the cross-section sample size increases.

Another disadvantage of panel data for the estimation of life-cycle models is that panel data can usually identify only elasticities with respect to long-run or life-cycle changes when analysing responses of individuals to year to year anticipated changes in wages and prices. On the other hand, panel data fail to identify short-run changes in labour supply. They estimate only the smaller life-cycle elasticities. This, as Blundell and Meghir

² By comparing panel and aggregate data Blundell and Meghir (1990, p.231) note: "For example, where individuals pass through periods of binding non-negativity constraints, panel data allows one to identify which individuals belong to each regime in each period of time. Aggregate data, on the other hand, necessarily averages across such individuals and bias due to aggregation may arise for two reasons . Firstly, preference parameters, prices, wage rates, constraints and access to financial markets may differ systematically across individuals in ways that do not satisfy the conditions for linear aggregation. Secondly, unobservable expectations may differ across individuals born at different dates in a way which invalidates the Euler equation underlying the life-cycle model of dynamic intertemporal behaviour. Entries and exits from the data may in this case invalidate the representative agent model of aggregate consumer behaviour."

(1990, p.232) stress, arises because:

"the range of valid instruments available to predict anticipated wage and price growth usually involve slowly changing variables and do not contain variables with high frequency".

To the disadvantages of panel data outlined above or to the lack of them, one can answer by constructing a "pseudo panel". A pseudo panel can be constructed by using, as Deaton (1985) suggests a time series of cross-sections. Means of the variables of interest for the same cohort are computed for each subsequent random cross-section. By following the same cohort over time, one is able to reconstruct cohort profiles for wages and employment where the cohort means substitute the individual observations. For instance, we can use Census data from 1950 to 1990 to reconstruct the life-cycle employment profile of women belonging to the 1930 birth-cohort. In order to do so, we have to group all the women born in 1930 for each cross-section. Then we compute their mean employment rates in each Census year. This procedure provides repeated observations over time for samples of individuals all born in 1930, all belonging to the same birth-cohort. Similarly, one can construct cohort employment profiles for the other cohorts.

A first advantage of using pseudo panel data is that they make possible to distinguish between cohort and ageing effects, differently from what happens if one uses only one cross-section to reconstruct "synthetic cohort employment profiles" (described in Chapter 2). In fact, given that pseudo panel data follow the same cohort over time, by comparing different birth-cohorts employment profiles they can separate out the change in employment due to the fact that people belong to a younger cohort from the changes simply due to ageing. For instance, if we compare the cohort employment profiles of women born in 1940 and of women born in 1960, we will be able to see whether a difference in their employment rate in 1980 occurs because at any given period of the

life cycle the two cohorts behaved differently or because they were in a different time of their life cycle.

The data set necessary to construct pseudo panel data, repeated cross sections (like Family Expenditure Survey for the U.K.) which provide information on random samples of individuals at several points in time, are common in many countries. Sample cohort means can therefore be used as a panel data for estimating a dynamic model when genuine panel data are not available (for application of this type refer to Deaton, 1985, Browning et al. 1985, Moffitt, 1988, and Blundell and Meghir, 1990).

The advantages and problems of using a pseudo panel have already been discussed by Deaton (1985) and by Micklewright (1990). We can summarize the following advantages of pseudo over genuine panel data:

1) pseudo panel data do not suffer from the attrition problem of panel data since new samples are drawn afresh each year and the representativeness is maintained. Moreover, if the criteria of defining the variables and their measurement methods are consistent over time for the cross-section, the pseudo panel can provide a valid cohort proxy to genuine panel for estimation of dynamic models. In some cases, as Moffitt (1991) finds for USA data, cross sections have more consistently defined questions over time than the available genuine panel;

2) another advantage of pseudo panel over genuine panel is, as Deaton (1985) stresses, that by using the pseudo panel one is able to recognize the measurement errors and to explicitly control for them while this is not always possible with genuine panel data. Moreover, as stressed by Blundell, Fry and Meghir (1990), grouping is likely to reduce measurement errors and cohorts can be expected to follow similar life-cycle profiles after adjusting for

differences in the observed characteristics across individuals in any cohort;

3) As Moffitt (1991) stresses pseudo panel data provide a link between micro and aggregate data. By comparing true and pseudo panel data one can discover whether the differences in parameter estimates from aggregate and panel data are the results of the panel nature of the latter or simply their individual, micro nature;

4) panel data are very costly to collect whereas in many countries repeated cross sections consistent over time are already available. This advantage is particularly relevant in countries, like most of the European countries, where genuine panel are not available;

5) pseudo panel can often cover longer periods (since cross sections have been repeated many times) than available panel data, which became available for most of the countries only in recent years.

However, there are also some disadvantages in using pseudo panel data that we must stress:

1) Since in order to construct pseudo panel data one has to average across cohorts, two main disadvantages (stressed by Blundell and Walker, 1986) occur:

1.1 - reduction in the underlying variation in both dependent and explanatory variables;

1.2 - difficulty in appropriately capturing the participation decision of those people showing high employment variation like married women.

2) sampling variation (which occurs since the samples for the

cross sections are drawn afresh each year) can cause fluctuation in the summary statistics used to construct cohort-profiles, as Micklewright (1990) stresses. The problem will be greater the smaller one makes the birth cohort. In general, as Micklewright (1990) stresses, if the determinants of survey response vary over time there will be a spurious change in the summary statistics obtained. This, as Micklewright (1990) adds can apply also to genuine panel data.

The analyses by Deaton (1985) and by Browning et al. (1985) show that a pseudo panel can provide data for the identification and consistent estimation of dynamic models (linear with fixed effects). Browning et al. (1985) have longitudinalized Family Expenditure Survey (FES) data from 1970 to 1977 in order to estimate a model of prime aged male labour supply. Moffitt (1988 and 1991) shows how, by imposing mild restrictions, one can identify and consistently estimate a larger set of dynamic models (for instance also models with discrete dependent variables in terms of transition rates) by using pseudo panel data.

For the application of the dynamic labour supply model described in Chapter 4, we will use one wave of a genuine panel for Germany with individual observations on past and forward employment status and on forward wages, and we will use a repeated cross section for the U.K. which has consistently defined questions over time in order to proxy past and forward values for some explanatory variables. For the estimation carried out in Chapter 8, we will therefore use a one year cross section enlarged by cohort proxies of individual variables (past and forward employment and forward wages). The cohort proxy of individual work experience has the advantage over the latter of not being endogenous in the employment probability equation.

Section 6.2 - Data

6.2.1 - U.K.: Family Expenditure Survey data

The optimal data set for a direct estimation of the dynamic model on married women's labour supply presented in Chapter 4 is a longitudinal survey containing data on women's forward and past work-experience and on their forward wages, apart from information on current hours of work, wages, household's characteristics, age and level of education. However, as far as the estimation of the model to U.K. data is concerned, we could not rely on panel data.

To our knowledge the only recent longitudinal survey which could have been used for our analysis is the Women and Employment Survey (thereafter referred to as WES).¹ This is a retrospective survey conducted in 1980 on a representative sample of 5,588 women aged from 16 to 59. A first objection to the use of this type of data is that retrospective surveys are often subject to recall errors. However, as found by Elias and Main (1982) and by Martin and Roberts (1984b), the risk of recall errors is only minimal for WES.

We have not used WES data for the estimation of our model, for different reasons. WES data contain information on current wages, but they do not contain information on forward wages and participation. Moreover, the retrospective information collected on work experience are not as detailed as the data on the employment status at the time of the WES interview. The above mentioned limitations of WES data would force us to use other surveys in order to construct cohort proxies to the individual variables which are crucial for our analysis and which are not present in WES data (past and forward work experience and forward wages). However, an additional objection to the use of WES data

¹ For a detailed description of WES data refer to Martin and Roberts (1984a and b). Main (1988a and b) uses WES data to estimate wage equations and to analyse women's labour market behaviour over their lifetime.

arises from the lack of updated surveys similar to WES. Actually, as we have mentioned above, WES refers to 1979 and to the retrospective career of women, and they have not repeated similar retrospective surveys in the UK afterwards. Moreover WES does not contain information on current consumption of the family, a variable which can highly simplify the application of our model as shown in Ch.4. Given the limitations in using WES for the estimation of our life cycle model on female labour supply and the lack of other longitudinal surveys useful for our estimation we have decided to exploit the available Family Expenditure Survey data (thereafter defined as FES).²

FES is a series of independent cross sections on a sample of around 10,400 households, representative of UK population, drawn afresh each year since 1957, of which about 70% decide to collaborate. The households interviewed are asked to keep an expenditure record for 14 consecutive days and to provide additional informations regarding both personal characteristics (age, sex, marital status, education, the latter only since 1978, employment status and type of work, hours of work and wages) and household's variables (like number and age of children).³

The main advantages that arise from FES data for the estimation of our theoretical model presented in Chapter 4 are the following:

- 1) FES data provide information on household's expenditure that
-

² The advantages of using FES data instead of General Household Survey (GHS) data have already been stressed by Gomulka and Stern (1986). Amongst the others FES data show a higher consistency across years than GHS.

³ On the reliability of income information of FES data refer to Atkinson and Micklewright (1983). As Gomulka and Stern (1986) stressed the information on household's income are more precise and detailed in FES data than in General Household Survey data.

can be used to estimate the model without having to estimate or proxy marginal utility of wealth;

2) the availability of a series of consistent cross sections⁴ over the period analysed (1982 to 1984) allows us to use FES data to recover cohort proxies of individual variables like past and forward work experience and forward wages. We are not aware of any other model which used FES as we did for the estimation of married women's labour supply models. Similarly we could have used the available different years of FES data in order to construct a pseudo panel to estimate our model.

3) FES data contain information on a set of variables which are considered by economic theory crucial for the decisions on labour supply of married women: amongst them number and age of children, employment status of husband, women's level of education and wages. At the same time FES data are a rich source on household's income variables.

In the following Section we will describe the process followed to construct cohort proxies.

⁴ Micklewright (1990) shows how FES data are not exempt of problems of consistency across years because of the change in the definition of the variables and for new variables included in more recent surveys. However these problems do not apply to the period of estimation that we have chosen.

6.2.2 - Variables used for the estimation of the model on U.K. data

The variables that we have used for the estimation of our model on FES data can be divided in two groups:

1) Personal variables which refer to married women's personal characteristics:

AGE = age of married women in 1983;
AGESQ = age of married women in 1983 squared;
COHORT = dummy taking 7 values:
= 1 if women were born from 1962 to 1966;
= 2 if women were born from 1957 to 1961;
= 3 if women were born from 1952 to 1956;
= 4 if women were born from 1947 to 1951;
= 5 if women were born from 1942 to 1946;
= 6 if women were born from 1937 to 1941;
= 7 if women were born from 1932 to 1936;

EDUC = years of schooling of woman;

WPARNS = dummy equal to 1 if the married woman is employed in 1983, at interview, 0 otherwise;

$\log w$ = log of the computed marginal net wage of married women in year 1983: (wife's weekly gross wage/wife weekly hours of work)*(1-wife's marginal tax rate) and deflated;

$\log l$ = log leisure of married women in 1983 = 120 - wife's weekly normal hours of work, where we assume that a working week is made out of 6 days and that at least 4 hours a day are devoted to rest;

EXP = cohort constructed measure of employment status in year 1982;

EXPF = cohort constructed measure of employment status in year 1984;

$\log WF$ = log of cohort and education constructed forward marginal wage for year 1984.

2) Household variables which refer to personal characteristics and to employment status of husband, to age and number of children in the household, and to household's consumption:

EDUCH	= years of schooling of husband;
HUNOCC	= 1 if husband is unemployed in 1983, = 0 otherwise;
HCLRK	= 1 if husband is clerk in 1983, = 0 otherwise;
HMANSK	= 1 if husband is in manual skilled position in 1983, = 0 otherwise;
HMUNSK	= 1 if husband is in manual unskilled position in 1983, = 0 otherwise;
HSER	= 1 if husband works in the Service sector in 1983, = 0 otherwise;
HIND	= 1 if husband works in Industry in 1983, = 0 otherwise;
D01	= 1 if the youngest child is from 0 to 1 year old in 1983, = 0 otherwise;
D23	= 1 if the youngest child is from 2 to 3 years old in 1983, = 0 otherwise;
D410	= 1 if the youngest child is from 4 to 10 years old in 1983, = 0 otherwise;
D1118	= 1 if the youngest child is from 11 to 18 years old in 1983, = 0 otherwise;
Nkids	= number of children in the household in 1983;
logc	= log of consumption of the household in year 1983 (expenditure on all items deflated by inflation).

Since FES does not follow the same individual over different years, data on individual past and forward work experience and on forward wages are not available. Given that these variables are crucial for the estimation of our model, we had to proxy them. In order to construct past work experience (EXP) we have computed the mean employment rates in 1982 of married women for each one of the seven cohorts mentioned above and according to the presence and age of the youngest child in the household (variables NKIDS, D01, D23, D410 and D1118) by using FES data for 1982. This procedure gave us a matrix with 35 elements. The values of EXP range from 0 to 1, the mean being 0.55 and its standard deviation 0.01. The same procedure applied to year 1984 allows us to construct a cohort proxy for forward work experience (EXPF). The mean value for EXPF is 0.51, it ranges from 0 to 0.83 and its standard deviation is 0.01.

Similarly since the FES data do not contain information on forward wages for each woman interviewed in 1983, we have proxied this variable by using a cohort constructed forward wage (WAGF). To construct it we have computed the mean marginal net wage of working married women in year 1984 according to their cohort (from 1 to 7), their level of education (less than 15 years of education, from 16 to 18 years of education, over 18 years of education) and the region where their household lives [Nord=(Scotland, North, North West and Yorks), Sud (South East) and Base (Midlands, East Anglia, South West and Wales)] in year 1984. This computation gave us a matrix of 63 cells. WAGF (our constructed forward wage) ranges from 0.66 to 2.00, its mean value is 1.19, and its standard deviation is 0.17.

We have then attached to each married woman's individual record the corresponding values for the cohort proxies of past and forward work experience and of forward wage rate according to their year of birth, number and age of the youngest child in the family and (for forward wages) according to birth year, level of education and residence.

6.2.3 - THE GERMAN SOCIO ECONOMIC PANEL

In order to estimate the dynamic model of labour supply on West German married women we have used the German Socio-economic Panel.¹

The German Socio-economic panel (SEP) is a genuine panel data started in 1984 interviewing around 6,000 families each year. The sample of families interviewed by SEP is representative of all the population living in West Germany.² Seven waves are available and the seventh wave contains also interviews on East German families. As it has been stressed by Hanefeld (1984), this is the first large Panel data in the Federal Republic of Germany focussing on the household and collecting, together with data on labour force participation of its members, also data on income and earnings. The survey collects at each wave information on current occupation, (earnings and hours), training, allocation of time,³ politics and social attitudes for each member in the household aged 16 or older (around 12,000 individuals),⁴ together with

¹ Apart from the study of Hujer and Schnabel (1990) we are not aware of any other dynamic model of female labour supply applied to this data set. The first wave of the panel has only been used for static analysis on female labour supply with taxes, and analyses on married men and singles' labour supply by Merz(1987,1990), Holst et al. (1988), Strom and Wagenhals (1988) and by Kaiser et al. (1989).

² On the way the sample has been constructed refer to Hanefeld (1984).

³ There is a question on the hours devoted to work, training or study, housework, watching television or reading and to other leisure activities separately for a week-day and for a holiday or Sunday, this question is asked to every person aged 16 or older belonging to the interviewed family. Moreover the same persons are asked about the frequency of various leisure activities.

⁴ Differently from other surveys (like the Michigan Panel Study of Income Dynamics), the questions are asked not only to the head of the household, but also to any individual aged 16 or older belonging to the household. One member of the household has to

general data on the whole family and on income, taxes and transfer payments.

In order to fill the gap on information on what happened to the individual between two subsequent surveys, retrospective questions are asked on monthly employment status, unemployment spells or other not working conditions for all the year preceding the interview. However only the average monthly earnings for each occupation is given, more detailed informations are collected for the current occupation. In the first interview a set of retrospective questions allows one to reconstruct the employment profile of the people taking part to it since they were 15 years old to 65.⁵

In Section 6.1 we have already outlined the problems that panel data can present for estimation. Amongst the general problems of panel data we can notice that the German Socio economic panel has a problem of attrition rate which though decreasing is still significant.⁶

The dynamic model that we want to estimate needs also information on past work experience and it must be noted that the retrospective informations collected by SEP interviews are not as accurate as current informations⁷. However this is just a minor

provide general informations on the household (like housing and transfer payments, or general informations on children in the family). Special attention has been given to foreigners, who have been oversampled and included in the SEP whereas they were considerably understudied by previous German surveys as Hanefeld (1984) stressed. People who split off the family are generally followed by the Panel in other waves as long as they stay in Germany.

⁵ The same type of questions are asked to individuals who join the Panel after the first wave.

⁶ As noted by Rendtel (1989) in 1988 only 69% of the respondents in the first wave were still present in the panel.

⁷ For instance, as Galler (1988) pointed out there is some evidence on substantial underreporting by women of unemployment spells in answers to retrospective questions.

disadvantage of SEP data since its genuine panel structure and the number of available waves allow us to recover the individual information for past and forward work experience that we need in order to estimate the model presented in Chapter 4.

However the SEP data do not contain informations on consumption of the household and this, as one can see by referring to Chapter 9, will make difficult to estimate a structural form model as we do with UK FES data. Another disadvantage of SEP data is that the measure of the wage rate is not directly provided in the interview and it is subjected to measurement errors, this, as it will be evident in Chapter 7, arises difficulties for the wage mobility analysis.

Differently from the estimation on UK data, we can now exploit the longitudinal nature of the SEP and use the individual information without having to use cohort proxies (as we did for past and forward employment status and forward wages for FES data). However, together with an estimation based on one wave of the SEP and on the individual panel observations for lagged and forward independent variables, we carry out an estimation procedure similar to the one performed for FES data in order to compare the results obtained.⁸

⁸ Actually the comparison between the estimates obtained for the same model in UK and West Germany must take into account the different institutional factors and labour market structures existing in the two countries, that we have outlined in Chapter 5.

Section 6.3 - Sample and variables definition a descriptive analysis

6.3.1 - The sample and some descriptive statistics for U.K. data

The sample that we have drawn from 1983 data is made of 1,791 married women from 17 to 51 years old. Table 6.1 below contains some information on the sample of married women drawn. The participation rate of married women in our sample is 57% against 87% for their husbands. Amongst them 911 have been employed (with positive wages and positive number of hours) as dependent workers in year 1983. The average net wage of working women in our sample is pounds 1.23 per hour (with a minimum of 0.17 pounds and a maximum of 4.11 pounds).

Tab.6.1 Descriptive Statistics on the subsample (*)

Variables	Mean	Standard Dev.
Age of woman	35.60	10.2
Number of children aged less than 18	1.33	1.1
Participation rate of women 1983	0.57	0.5
Participation rate of their husbands 1983	0.87	0.3
Husband's unoccupied	0.01	0.1
Married women unoccupied	0.41	0.5
Age of school leaving for women	15.86	1.6
Wage of working married women	1.23	1.3

(*) Our computations from Family Expenditure Survey Data - 1983

Turning to family structure we notice that the mean number of children in the family is of 1.3. Tab.6.2 below shows the percentage of married women in the sample by age of the youngest child in the family.

**Tab.6.2 - Married women in the sample by
age of the youngest child in the family (*)**

age of the child	% of married women
0 - 1	17.2
2 - 3	12.5
4 - 10	24.3
11 - 18	14.8

(*) Our computations from Family Expenditure Survey Data - 1983

The mean regional male unemployment rate in 1983 is 15.8%. Employed women tend to be clustered in the Service sector, and in clerical or in manual unskilled position as Tab.6.3 below shows.

Tab.6.3 - Employment rate by sector, job and sex. 1983 (*)
(**)

	wives	husbands
clerical	58.3	9.2
manual skilled	6.2	40.8
manual unskilled	35.6	18.4
Service Sector	46.3	25.8
Industry	21.5	16.4

(*) Our computations from Family Expenditure Survey Data - 1983

(**) percentages: married women (or married men) employed in position i divided by all working married women (or married men) in our sample multiplied by 100.

6.3.2 - DESCRIPTIVE ANALYSIS OF SEP SUBSAMPLE USED

6.3.2.1 - Analysis of the SEP subsample

The subsample that we have used for the application of our model to SEP data is made up of 1,169 German married women aged from 25 to 54 in 1987, who took part to all the waves of the Panel, who have been continuously married to the same man (we have selected only German couples) since 1983 and whose partner has continuously lived within the family throughout the Panel years. The latter restrictions have been made since we expect that these types of married couples significantly differ in their labour market behaviour with respect to others. Tab.6.4 (Appendix 2) contains a few descriptive statistics on the subsample.¹

We have used different measures for employment rates: **PAR87** takes the value of 1 if the woman interviewed has been employed or self-employed in the week preceding the 1987 interview, and 0 otherwise. The variable **EXP87** takes the value of 1 if she was working at least during one month in year 1987 for a positive number of hours and getting a positive wage (even if she was not working in the week preceding the interview) and 0 otherwise. The latter measure of employment was higher in all the waves (57% of the women in our sample were employed according to variable **EXP87** in year 1987, whereas 53% were employed or self-employed in week preceding 1987 interview) but one must notice that the retrospective interview does not provide precise informations on wages and hours of work, so we consider **EXP87** (constructed by using last year retrospective information) less reliable for the reconstruction of women's employment status than the variable **PAR87** constructed by using current information.

¹ A list of all the variables in our study is to be found in Appendix 1 to this Chapter.

Employment rates in part-time jobs are higher than employment rates in full-time jobs (in 1987 part-time employment rate was 0.31 while full-time employment rate was 0.22) as Tab.6.4 in Appendix II shows.

Even if the work-profile that we have constructed by using wave 1984 till wave 1988 of the Socioeconomic Panel is limited to a few years,² one can see how the employment rate is increasing over the life-cycle for younger cohorts even if the youngest cohort does not show to follow this pattern (refer to Tab.6.5 in Appendix 2 to this Chapter). As Tab.6.5 shows, women in childbearing or childrearing years have a higher probability of being employed over the year of interview rather than in the week preceding the interview, this may be connected with a higher diffusion in this age group of temporary jobs or of maternal leaves which, as we have discussed in Ch.5, are more favorable in West Germany than in the U.K.

Turning to education the average years of education are 11 for married women in our sample and 12 for their husbands.³

The employment rates are higher for those women in our sample with University degree (68.2% of them were employed in week preceding 1987 interview) or with a Technical College Degree (Fachhochschule) (of the latter 60.9% have been employed in week preceding 1987 interview) as Tab.6.6 in Appendix II show.

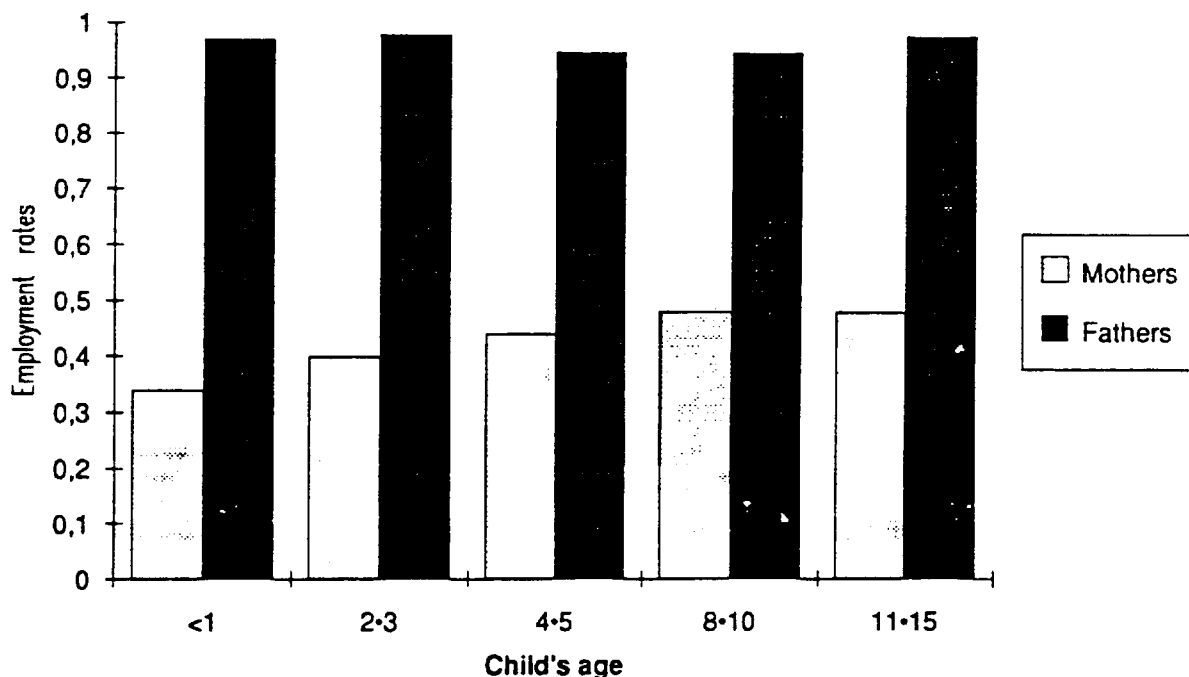
The presence in the family of young children decreases the employment rates of married women in our sample. As Tab.6.7.a in Appendix II and Graph 6.1 below show the younger is the youngest child

² We do not exploit the retrospective information on the employment condition of women since they were 15 years old, which is contained in the first interview they have when they join the Socio-Economic Panel because it is affected by a great recall problem.

³ The number of years of formal education is not directly provided by the survey and we have constructed this variable by using the information on the highest level of education completed by the respondent and by considering the average number of years necessary to complete that level of education as the individual number of years of education.

in the family, the lower are the employment rates of their mothers (they range from 34.2% in families where the youngest child is aged less than 1 to 48% in families where the youngest child is from 11 to 15 years old), whereas their fathers' employment rates do not change significantly.

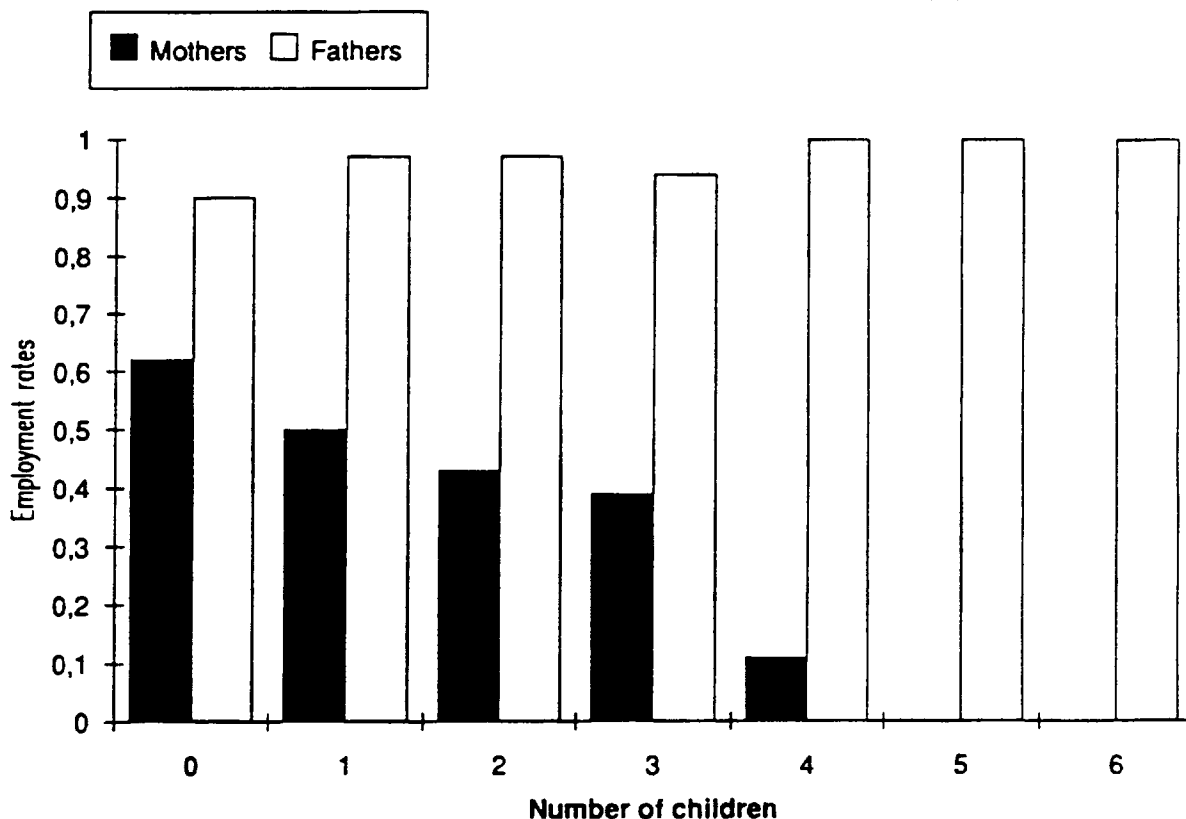
GRAPH 6.1 - EMPLOYMENT RATES OF MARRIED MEN AND WOMEN IN WEEK BEFORE 1987 INTERVIEW BY AGE OF THE YOUNGEST CHILD IN THE FAMILY



Employment rates of married women in our sample are inversely related to the number of children aged less than 15 in the family. In fact as Tab.6.7.b in the Appendix and Graph 6.2 below show, for women with no children aged less than 15 the employment rate is 0.62 while for women with 4 children aged less than 15 the employment rate is 0.11.

GRAPH 6.2 - EMPLOYMENT RATES OF MARRIED MEN AND WOMEN

**IN WEEK BEFORE 1987 INTERVIEW
BY NUMBER OF CHILDREN IN THE FAMILY**



Also the presence of people in the family requiring special assistance (elderly with some illness problem or handicapped requiring assistance) (NEED=1) decreases the employment rates of married women (from 51.7% if there are no people in the family needing assistance to 42.5% if there are people needing assistance in the family).

The presence of chronic diseases does not sensibly reduce the employment rates of women in our sample (Tab.6.8.b, in App.2). The employment rate of those women in our sample who are certified as having a reduced capacity to work or being severely handicapped is even higher than others (Tab.6.8.c, in App.2). Probably these employment rates are affected by the existing constraint on firing people on the basis of poor health or by the laws which encourage the hiring of handicapped persons.

Those women who had substantial health impediment have a lower employment rate in week preceding 1987 interview than others (see Tab.6.8.a, in App.2).

As Tab.6.9 shows the employment rate of women in the week preceding 1987 interview is lower if their husbands were unemployed in week preceding 1987 interview, (if this was the case women's employment rate in week preceding 1987 interview was 48.6% against 52.5% for wives of employed husbands) this could be a first sign of the existence of a discouraged worker effect, however we should stress that the difference between the employment rate of women married to unemployed and the others is not significant at 95% level of confidence.⁴

Women married to self-employed men report the highest participation rates (76.2% of them were employed in week preceding 1987 interview) together with wives of part-timers and irregular workers. This is in line with the results obtained by other analyses on married women's participation rates in FRG (see Chapter 5 on these analyses).

As far as the geographic distribution of married women's employment rates is concerned women's employment is higher in the metropolitan areas with more than 500,000 inhabitants (Tab.6.10 in App.2), and (as we expected) in the following bundesland: Bremen (75% of those living in this bundesland were employed in week preceding 1987 interview), Berlin and Hamburg, while the lowest employment rates are in Rheinland-Pfalz and in Saar (25.6%).(Tab.6.11 in App.2). This is probably due to a higher importance in the areas with more than 500,000 inhabitants of the Service Sector where women are generally employed in higher percentage.

During the interview women are asked about the number of hours they wish to work (they are warned in the question about the possibility that their earnings can vary according to how many hours they will work), this answer (variable WHRSW) allows us to construct a measure of the

⁴ Moreover, this negative effect may also be connected to the type of benefit received by the unemployed husband. For a more accurate analysis on the effect of the presence of unemployed husband on his wife's labour supply refer to Micklewright and Giannelli (1991).

constraints on women's hours of work in our subsample by comparing WHRSW with the stated actual hours of work in the week preceding 1987 interview.

We have defined three dummies variables (CONS1, CONS2 and CONS3) as follows:

CONS1 = 1 If desired hours of work > actual hours

CONS1 = 0 otherwise

CONS2 = 1 if desired hours of work < actual hours

CONS2 = 0 otherwise

CONS3 = 1 If desired hours of work = actual hours

CONS3 = 0 otherwise

According to the results shown in Tab.6.12.a 10% of the married women in our sample wish to work more hours than they actually do, while 22.4% of them would like to work less hours than they do and 67.5% are satisfied with their number of hours of work. Amongst those women who work less hours than they would like to, the majority belongs to the cohorts born from 1948 to 1952 (23%) and from 1938 to 1947 (26%) (Tab.6.12.b). Amongst part-timers 32% would like to work less hours than they do and 19% would like to work more hours than they do (Tab.6.13 in App.2).

In order to have an idea of the type of constraints that women face when they work part-time it is useful to analyse the data in Tab.6.14. Tab.6.14 shows the reasons that women gave to their part-time working by answering a specific question raised during the interview. According to these answers, most women were working part-time in week preceding 1987 interview for family reasons (42% of women working part-time stated that they did so specifically in order to raise up their children and 24.5% for other family reasons). Only 4% of married women working part-time declared that they wished to work more but that they did not find a full-time job. Since women working part-time have lower gross hourly wages than women working full-time at most level of education and types of job considered (see Tab.6.15 and 6.16 in Appendix II) and family reasons are the most important factors affecting the decision of working

part-time for the married women belonging to our sample, one can state that "family needs" bear an important role in determining the level of pay of German married women via their effects on part-time working.

6.3.2.2 - Transition in employment status and analysis of wage differential by gender

This sub-section is devoted to analyse whether the women in the sample are characterized by continuity in the employment status over the waves analysed. We will investigate whether employed women still stay employed over the period analysed and if they stay in full-time or part-time employment, or if they become not employed. We will also analyse whether in the sample used one can find wage differentials by gender.

There is evidence of persistence in employment since the data available show that those women who were employed in week preceding 1987 interview, 90.1% were employed also in week before 1986 interview (98% sometimes during year 1986) and 90.1% have been employed also in week preceding 1988 interview.

Tab. 6.17 below contains data on job mobility for women working in 1984. Married women who were working part-time in year 1984 are characterized by a decreasing percentage of part-timers and an increasing presence of full-timers amongst them, and after 4 years 13.5% of them were no more part of the labour force. This while amongst full-timers in 1984, there is an increasing tendency towards part-time work (in 1988, 17.4% of them worked part-time) and a decrease in the percentage of women still working full-time (if in 1985, 81% of full-timers in 1984 were still working in a full-time job, this percentage fell to 64% in 1988, as one can see from Tab.6.17.b).

Of all employed women in 1984, 17% were not employed in year 1988 (Tab.6.17.c) and of those who were not employed in year 1984, 75% were still not employed after four years.

Tab.6.17.a - Job Mobility since 1984 for part-timers women in 1984 (*) (%)
(on total of 223 part-timers)

Years	Part-timers		Full-timers		Not-employed	
	n	%	n	%	n	%
1985	180	80.7	20	9.0	14	6.3
1986	160	71.7	22	9.9	27	12.1
1987	161	72.2	30	13.5	25	11.2
1988	156	70.0	32	14.3	30	13.5

Tab.6.17.b - Job Mobility since 1984 for full-timers women in 1984 (*) (%)
(on total of 242 full-timers)

Years	Part-timers		Full-timers		Not-employed	
	n	%	n	%	n	%
1985	22	9.1	197	81.4	18	7.4
1986	29	12.0	186	76.9	23	9.5
1987	37	15.3	168	69.4	34	14.0
1988	42	17.4	154	63.6	43	17.8

Tab.6.17.c - Job Mobility since 1984 for working women in 1984 (*) (%)
(on total of 579 working women)

Years	Part-timers		Full-timers		Not-employed	
	n	%	n	%	n	%
1985	262	45.3	221	38.2	53	9.2
1986	223	38.5	217	37.5	75	13.0
1987	249	43.0	208	35.9	87	15.0
1988	259	44.7	193	33.3	99	17.1

(*) Our computations on the German SocioEconomic Panel

Tab.6.17.d - Job Mobility since 1984 for not working women in 1984
 (*)(% on total of 590 not working women)

Years	Part-timers		Full-timers		Not-employed	
	n	%	n	%	n	%
1985	42	7.1	13	2.2	507	85.9
1986	41	6.9	19	3.2	494	83.7
1987	65	11.0	23	3.9	464	78.6
1988	80	13.6	28	4.7	445	75.4

(*) Our computations on the German SocioEconomic Panel

Turning to the analysis of wage differentials by gender, in Tab. 6.18 one can observe the level of gross earnings and of gross hourly wages for women in different birth cohorts from 1986 to 1988, while Tab.6.19 shows the same figures for women and men having different level of education referred to year 1987. From Tab.6.19 one can notice the persistence of a high wage differential by gender (taking the level of education as given) across full-timers and part-timers. The same holds true if one compares mean gross hourly wages by sex for manual workers, public workers, self-employed, clerical workers (Tab.6.15) and for all part-timers and full-timers workers (Tab.6.16). As we expected the lower difference by gender in mean gross hourly wages is to be found amongst public workers. Still in 1988 women's gross wages as a percentage of men's were 76% in full-time jobs and 58% in part-time jobs, in 1987 women's wages in full-time public workers jobs were 90% of those of men's while in full-time clerical jobs they were 64.2% of those of men in the same position. The greatest differential is to be found amongst self-employed (see Tab.6.15, for data on wages and earnings mobility refer to Ch.7).

Section 6.4 - The econometric model and its application to the available data set

One of the aims of the application of the theoretical model described in Chapter 4 to U.K. and German data is to show how the results change when one relaxes the assumption of intertemporal separability of the lifetime budget constraint.

In the application of our theoretical model we do not account for fixed costs related to the presence of young children in the family in the budget constraint given to lack of data. We do assume perfect capital market and we do not assume endogenous fertility in this model. The included child status variables are not in the model only to improve the Standard Errors of income and wage effects.¹ We include child status variables in the utility function as factors affecting leisure and consumption because, consistently with time-allocation models we deem younger children more mother's time intensive and we consider older children as increasing the consumption in the family. We are aware of the possible bias in the child status variables coefficients due to the correlation between the included exogenous child status variables and the labour supply decisions. We cannot rule out the "fertility bias" by limiting our analysis to one period and by considering dummies referred to children older than one, because our model is a dynamic model of labour supply, where we take into account also past and forward values for work experience and wages. Over the life cycle it is difficult to claim that fertility and labour supply are not simultaneously determined or that there are not omitted variables affecting both fertility and labour supply choices leading to possible bias of the child status variables included in the model. By first differencing one can rule out the bias arising because of

¹ On the different reasons for introducing child status variables in models of female labour supply refer to Nakamura and Nakamura (1990).

unobservable fixed effects affecting both child status variables and female labour supply decisions, as suggested by Nakamura and Nakamura (1985a, 1989). However, we force fertility to be exogenous in our simplified model of female labour supply whose main aim, as already stressed, is to endogeneize wages breaking the assumption of intertemporal separability of the lifetime budget constraint.

More educated women will, according to our model, have a higher accumulated human capital and so given the positive impact of this variable on their wages they are expected to have a higher probability of participation in the labour market. However, consistently with the evidence surveyed in Chapter 3, we expect more educated women to spend more time in child care than other women. It could be interesting to test whether, amongst married women with a young child, the human capital-wage effect prevails on the higher inputs of mother's time for more educated women. In general we expect that the presence of a young child in the family on her mother's labour supply will differ according to her past work experience and her level of education.

The estimation of the model presented in Chapter 4 can be done in 4 steps, if one observes data on the household's consumption, as well as data on female labour supply:²

- 1) estimation of a Probit on the probability of employment of the married women included in the sample;
- 2) estimation of the log wage equation implied by the theoretical model and corrected for selection bias;
- 3) estimation of log of Consumption equation to substitute away the marginal utility of wealth term from the log-leisure equation;
- 4) 2 stage least squares or Tobit estimation of the log leisure demand

² We do observe both female labour supply and household's consumption in the British data but the available panel data for Germany does not contain data on household's consumption as we have discussed in the previous sections.

equation 9.a from 8'' presented in Chapter 4, assuming that all the effects of consumption on leisure demand come directly through the actual or predicted consumption (C) and not through the observed factors affecting it (B).

$$\log L_{i,t}$$

$$= \frac{\mu - 1}{\alpha - 1} \log C_{i,t} + (1/\alpha - 1) \log [W_{i,t} + (\beta_2 + \beta_4 \text{ EDUC}_i) W_{i,t+1}^e (T - L_{i,t+1}^e)]$$

$$- (a/\alpha - 1) \Omega_{i,t} - (1/\alpha - 1) \epsilon_{i,t} \quad 9.a$$

$$\log L_{i,t}$$

$$= c_1 \log C_{i,t} + c_2 \log W_{i,t} + c_3 (\beta_2 + \beta_4 \text{ EDUC}_i) + c_4 W_{i,t+1}^e + c_5 (T - L_{i,t+1}^e)$$

$$+ c_6 \Omega_{i,t} + \epsilon_{i,t} \quad 9.b$$

where

$L_{i,t} = (T - h_{i,t})$ = leisure hours for married woman i in period t;

$C_{i,t}$ = consumption of the i-th woman's household in period t;

$(1/\alpha - 1)$ = intertemporal substitution elasticity. Strict concavity of the utility function in Chapter 4 requires that α is less than 1.

$W_{i,t}$ = wage for woman i at time t;

EDUC_i = level of education for woman i;

$W_{i,t+1}^e$ = expected level of forward wages for woman i;

$T - L_{i,t+1}^e$ = expected forward hours of work for woman i;

$\Omega_{i,t}$ = observed factors affecting leisure (demographics, level of

husband's education, level of unemployment in the region...)

$\epsilon_{1,it}$ = unobserved factors affecting leisure.

In this stage one can test for the significance of the predicted against the actual measures for wages and consumption in the right hand side of the model and estimate also a loglinear approximation of (9.a), i.e equation (9.b) above.

The estimation of the Structural form 9.a will allow us to recover estimates of important parameters like the intertemporal substitution elasticity $1/(\alpha-1)$ and the substitution parameter α , and to carry out comparisons with other analyses.

As we will discuss more in depth in Ch.9, when dealing with the German panel data, the estimation of the leisure demand equation (8') in Section 4.1 (Chapter 4), for our model is more difficult if one cannot observe the household's consumption. In this case it is not possible to substitute away $\phi_{1,t}$ (the marginal utility of net worth in equation 8' of Chapter 4) from the Consumption equation, and we are left with the following structural form to be estimated:

$$\begin{aligned} \log L_{1,t} = & \\ = (1/(\alpha-1)) \log \phi_{1,t} + (1/(\alpha-1)) \log [W_{1,t} + (\beta_2 + \beta_4 \text{ EDUC}_1) W_{1,t+1}^e (T-L_{1,t+1}^e)] & \\ - (a/(\alpha-1)) \Omega_{1,t} - (1/(\alpha-1)) \epsilon_{1,it} & \quad 9.c \end{aligned}$$

If one assumes that $\phi_{1,t}$ is constant over time for each individual one can use a fixed effect approach and first differences. However, the presence in the Right hand side of equation (9.c) above of forward terms in wages and hours of work makes it necessary to use

Instrumental Variables.

On the other hand one can use a random effect approach and proxy $\theta_{i,t}$ with all lags and leads of other variables considered as strictly exogenous to the participation decision of married women. Hujer and Schnabel (1990) in their dynamic model on female labour supply in West Germany have used fertility and household's income to proxy the marginal utility of net worth. One can question whether it is a stronger assumption to assume exogeneity of fertility to married women's labour supply rather than considering $\theta_{i,t}$ constant over time.

In Chapter 9 we estimate a quasi-reduced form of the life cycle model of female labour supply, with the effect of current employment decision on forward wages which enters the payoff function of current employment and a bivariate probit for the employment probability and the probability of working full-time, by using one wave of the German Panel data enriched with individual observations on lagged and forward explanatory variables.³

³ As mentioned in the previous Sections we will estimate the model also by using cohort proxies for lagged and forward explanatory variables instead of the individual observations provided by the Panel.

Section 6.5 - CONCLUSIONS

In this Chapter (Section 6.1) we have analysed the advantages and disadvantages of genuine panel and pseudo panel data which have been used to estimate most of the Frisch demand models of labour supply surveyed in Part I. In the application of our dynamic model of female labour supply described in Chapter 4, we will use one cross section for the U.K. (Family Expenditure Survey data - FES) and one wave of the German SocioEconomic Panel (SEP) enriched with cohort proxies (from FES and SEP data) or individual panel observations (from SEP data) for the lagged and forward values of the explanatory variables included in the model. In Section 6.2.2, we have described how cohort proxies have been constructed. We should notice that, as stressed when dealing with pseudo panel data in Section 6.1, the constructed cohort proxies have the disadvantage of reducing the underlying variation of the individual explanatory variables proxied, since they have been constructed by using cohort means.

We have described the data set and the samples used in Sections 6.2 and 6.3. In the latter Section we have devoted particular attention to the analysis of the change in employment status experienced by the German married women in our sample over different waves (Section 6.3.2.2).

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In Section 6.4, we have described the difficulties which arise when we try to estimate the dynamic model on labour supply presented in Chapter 4 on data which do not contain information on household's consumption (and this is the case for the German data set used). On the other hand, when household's consumption data are available (as in the case of U.K. data) we have shown the different steps which lead to the estimation of a structural form for our model.

APPENDIX I

INDEX OF THE VARIABLES USED

DEMOGRAPHIC VARIABLES

AGE = age of married women;

AGESQ = age of married women squared;

COHORT = 1 if women are aged from 25 to 29 in 1987

= 2 if women are aged from 30 to 34 in 1987

= 3 if women are aged from 35 to 39 in 1987

= 4 if women are aged from 40 to 44 in 1987

= 5 if women are aged from 45 to 49 in 1987

= 6 if women are aged from 50 to 54 in 1987;

GEBJAHR = birth year of wife

D01 = dummy variable taking the value of one if the youngest child in the family is one year old or younger, equal to 0 otherwise;

D23 = dummy variable taking the value of one if the youngest child in the family is aged from 2 to 3, equal to 0 otherwise;

D45 = dummy variable taking the value of one if the youngest child in the family is aged from 4 to 5, equal to 0 otherwise;

D610 = dummy variable taking the value of one if the youngest child in the family is aged from 6 to 10, equal to 0 otherwise;

D1115= dummy variable taking the value of one if the youngest child in the family is aged from 11 to 15, equal to 0 otherwise;

NKID = number of children aged less than 15 in the family in year 1987;

AGEH = age of husband.

HEALTH OF WOMEN

- IMPH** = degree of impediment of health in carrying out day-to-day activities (job or training)
= 1 no impediment
= 2 a little
= 3 substantial
- CRILL** = 1 if the person interviewed suffered for at least one year or chronically from specific complaints or illness
= 0 otherwise
- HANDC** = 1 if person interviewed has been officially certified as having a reduced capacity to work or being severely handicapped,
= 0 otherwise

EMPLOYMENT VARIABLES REFERRED TO WIVES

- PAR84** = 1 If woman interviewed has been employed during week preceding 1984 interview,
= 0 otherwise;
- PAR85** = 1 If woman interviewed has been employed during week preceding 1985 interview,
= 0 otherwise;
- PAR86** = 1 If woman interviewed has been employed during week preceding 1986 interview,
= 0 otherwise;
- PAR87** = 1 If woman interviewed has been employed during week preceding 1987 interview,
= 0 otherwise;
- PAR88** = 1 If woman interviewed has been employed during week preceding 1988 interview,
= 0 otherwise;
- PAR86F** = 1 If woman interviewed has been full-time employed during week preceding 1986 interview, (*)
= 0 otherwise;
- PAR86P** = 1 If woman interviewed has been part-time employed during week preceding 1986 interview, (**)
= 0 otherwise;
- PAR87F** = 1 If woman interviewed has been full-time employed during week preceding 1987 interview, (*)
= 0 otherwise;

(*) if she states to be working full-time and works 35 hours or more in the week before the interview

(**) if she states to be working part-time and works less than 35 hours in the week before the interview

PAR87P = 1 If woman interviewed has been part-time employed during week preceding 1987 interview,
= 0 otherwise;

PAR88F = 1 If woman interviewed has been full-time employed during week preceding 1988 interview,
= 0 otherwise;

PAR88P = 1 If woman interviewed has been part-time employed during week preceding 1988 interview,
= 0 otherwise;

EXP86 = 1 If the woman interviewed has been working somewhen during year 1986 (even if not working in week preceding 1986 interview).
= 0 otherwise;

EXP87 = 1 If the woman interviewed has been working somewhen during year 1987 (even if not working in week preceding 1987 interview).
= 0 otherwise;

WORK86 = mean employment rate (referred to week preceding 1986 interview) for women in the sample in different cohort groups and for different age of the youngest child, used to construct a cohort proxy for past work experience,

WORK88 = mean employment rate (referred to week preceding 1988 interview) for women in the sample in different cohort groups and for different age of the youngest child, used to construct a cohort proxy for forward work experience,

WOR86 = mean employment rate (referred to year 1986 i.e. by using EX86 variable) for women in the sample in different cohort groups and for different age of the youngest child, used to construct another cohort proxy for the individual past work experience,

WOR88 = mean employment rate (referred to year 1988 since EX88 is not yet available we used EX87 so it is less reliable than WORK88) for women in the sample in different cohort groups and for different age of the youngest child, used to construct another cohort proxy for the individual forward work experience,

VF83 = months in full-time employment for women interviewed in year 1983;

VP83 = months in part-time employment for women interviewed in year 1983;

VF84 = months in full-time employment for women interviewed

in year 1984;

VP84 = months in part-time employment for women interviewed in year 1984;

VF85 = months in full-time employment for women interviewed in year 1985;

VP85 = months in part-time employment for women interviewed in year 1985;

VF86 = months in full-time employment for women interviewed in year 1986;

VP86 = months in part-time employment for women interviewed in year 1986;

VF87 = months in full-time employment for women interviewed in year 1987;

VP87 = months in part-time employment for women interviewed in year 1987;

ORE87 = hours worked in year 1987 by each woman interviewed (constructed by multiplying months in part-time work and in full-time work during year 1987 by the number of hours she actually worked in week preceding 1987 interview or by the average number of hours women in the sample worked if in full-time work or in part-time work);

OR87F = hours of work in full-time jobs of women interviewed during year 1987;

OR87P = hours of work in part-time jobs of women interviewed during year 1987;

DP41 = hours worked on average by each woman in week preceding 1987 interview (they include also overtime work);

DP4401 = gross earnings (monthly average) for month preceding 1987 interview for women;

DP4402 = net earnings (monthly average) for month preceding 1987 interview for women;

WAGW = wife's net hourly wage for month preceding 1987 interview = $DP4402 / (4 * DP41)$;

LOGW = log of WAGW;

GROSW = wife's gross hourly wage for month preceding 1987 interview = $DP4401 / (4 * DP41)$;

LOGWG = log of GROSW;

WAG86 = mean net hourly wage in 1986 constructed by using cohort, level of education (PERSC3) used to construct a cohort proxy for individual wages;

WAG286 = mean net hourly wage in 1986 constructed by using cohort, level of education (PERSC2) used to construct a cohort proxy for individual wages;

WA86 = mean gross hourly wage in 1986 constructed by using cohort, level of education (PERSC3) used to construct a cohort proxy for individual wages;

WAG88 = mean net hourly wage in 1988 constructed by using cohort, level of education (PERSC3) used to construct a cohort proxy for individual wages;

WA88 = mean gross hourly wage in 1988 constructed by using cohort, level of education (PERSC3) used to construct a cohort proxy for individual wages;

WHRSW = weekly number of hours women interviewed wished to work in year 1987;

CONS1 = 1 if WHRSW > DP41,
= 0 otherwise;

CONS2 = 1 if WHRSW < DP41,
= 0 otherwise;

CONS3 = 1 if WHRSW = DP41,
= 0 otherwise;

LMKTP = 1 if woman works part-time in 1987 because she cannot find full-time job;
= 0 otherwise;

EDUCP = 1 if woman works part-time in 1987 because she does not want to or cannot in order to grow up her children;
= 0 otherwise;

FAMP = 1 if woman works part-time in 1987 because of other family reasons,
= 0 otherwise;

LEISP = 1 if woman works part-time in 1987 because she wants more free time;
= 0 otherwise;

OTHP = 1 if woman works part-time in 1987 because of other reasons,
= 0 otherwise;

DBRANCHE = sector of employment for wife;

DISCO = Isco code of job of wife;

DIWEGENER, DISCOU and DISCOH = social scale for wife's occupation;

MANW = 1 if woman is employed as manual worker,
= 0 otherwise;

CLERKW = 1 if woman is employed as white collar,
= 0 otherwise;

PUBW = 1 if woman is employed as Public Sector employee,
= 0 otherwise;

SELFW = 1 if woman is self-employed,
= 0 otherwise;

APPW = 1 if woman is apprentice,
= 0 otherwise;

ATTW = occupational status of wife:
= 1 if working full-time
= 2 if workin part-time
= 3 if in vocational training
= 4 if irregular or casual employed
= 5 if registered as unemployed
= 7 if not active.

NEMP = number of employees in firm where woman interviewed works
= 1 less than 20
= 2 20-199
= 3 200-1999
= 4 2,000 and more
= 5 not employed or self-employed

EDUCATION

EDUC = years of schooling of wife;

EDUCH =years of schooling of husband;

REAL = 1 if the woman interviewed has Realschule (i.e. intermediate level of education) as her highest level of education,
= 0 otherwise;

ABIT = 1 if the woman interviewed has Abitur (i.e. Gymnasium) as her highest level of education,
= 0 otherwise;

UNIV = 1 if the woman interviewed has University
 Degree as her
 highest level of education,
 = 0 otherwise;

FACHO = 1 if the woman interviewed has Technical College
 as her highest level of education,
 = 0 otherwise;

FACHU = 1 if the woman interviewed has Specialized Technical
 Training
 as her highest level of education,
 = 0 otherwise;

LEHRE = 1 if the woman interviewed has Apprenticeship,
 = 0 otherwise;

BERUF = 1 if the woman interviewed has completed General
 Vocational Training,
 = 0 otherwise;

BRFA = 1 if FACHU EQ 1 or Beruf equal 1;
 = 0 otherwise;

CIV = 1 if the woman interviewed has completed Civil
 Servant Training,
 = 0 otherwise;

PUB = 1 if the woman interviewed has completed a
 Public Health School,
 = 0 otherwise;

ABFA = 1 if person interviewed has an intermediate level of
 education; = 0 otherwise;

UNFA = 1 if person interviewed has University or Technical
 College Degree;= 0 otherwise;

BRLE = 1 if person interviewed has vocational training or
 apprenticeship;= 0 otherwise;

EDEX = (EDUC*PAR86F);

EDWOR = (EDUC*PAR86);

EDWOR2 = (EDUC*ORE86);

EDWOR3 = (EDUC*ORE85);

EDWOR4 = (EDUC*ORE84);

PERSC2 = 1 if EDUC less or equal 12
 = 2 if EDUC greater than 12 and less than 17

= 3 if EDUC greater or equal 17;
 PERSC3 = 1 if EDUC less or equal 12
 = 2 if EDUC greater than 12 and less or equal 17
 = 3 if EDUC greater or equal 19.

HOUSEHOLD VARIABLES

HUNOCC = 1 if husband unemployed,
 = 0 otherwise;

PAR87H = 1 if husband employed,
 = 0 otherwise;

MANH = 1 if husband is employed as manual worker,
 = 0 otherwise;

CLERKH = 1 if husband is employed as white collar,
 = 0 otherwise;

PUBH = 1 if husband is employed as Public Sector employee,
 = 0 otherwise;

SELFH = 1 if husband is self-employed,
 = 0 otherwise;

APPH = 1 if husband is apprentice,
 = 0 otherwise;

ATTH = occupational status of husband:
 = 1 if working full-time
 = 2 if workin part-time
 = 3 if in vocational training
 = 4 if irregular or casual employed
 = 5 if registered as unemployed
 = 7 if not active.

INC87F = net income of the family, excluding wife's salary;

OY = other household's income (including also income from
 let and lease);

NETINM = INCF87/100;

NETINY = yearly net income (divided by 1,000);

LET1 = 1 if household received income from let and lease in
 1987,
 = 0 otherwise;

LETY = gross annual income from let and lease of the family
 in year 1987;

LETM = gross monthly income from let and lease of the family
in year 1987;

SPLEY = yearly maintenance and other cost of houses in let
and lease
belonging to the family, divided by 1000 in 1987;

SPLEM = monthly maintenance and other cost of houses in let
and lease
belonging to the family, divided by 100 in 1987;

INCLEM = net monthly income from let and lease of the family
in year 1987;

INCLEY = net yearly income from let and lease of the family
in year 1987;

INCY = yearly income from interests and dividends of
household in 1987
= 1 less than 500 DM
= 2 500-2,000
= 3 2,000 - 5,000
= 4 5,000 - 10,000
= 5 more than 10,000;

BABS = 1 if there is a baby sitter taking care of the
children,
= 0 otherwise;

NEED = 1 if there are in the family people requiring special
assistance,
= 0 otherwise;

INHA1 = number of inhabitants in the metropolitan area where
family lives
= 0 more than 500,000 City (C)
= 1 more than 500,000 Remaining area (R) i.e.
outskirts or other areas of the metropolitan region
which are called "supplementary areas" and
"metropolized areas".
= 2 100,000-500,000 C
= 3 100,000-500,000 R
= 4 50,000-100,000 C
= 5 50,000-100,000 R
= 6 20,000- 50,000 C
= 7 5,000- 20,000
= 8 2,000- 5,000
= 9 less than 2,000

INHA2 = number of inhabitants in area where family lives
= 1 less than 2,000
= 2 2,000 - 5,000
= 3 5,000 - 20,000
= 4 20,000 - 50,000

= 5 50,000 - 100,000
 = 6 100,000 - 500,000
 = 7 more than 500,000

BUNDES = bundesland where family lives

= 0 Berlin
 = 1 Schleswig-Holstein
 = 2 Hamburg
 = 3 Niedersachsen
 = 4 Bremen
 = 5 Nordrhein-Westfalen
 = 6 Hessen
 = 7 Rheinl-Pfalz, Saarl
 = 8 Baden-Wuerttemberg
 = 9 Bayern

HUS1 = 1 if family has household benefit in 1987
 = 0 otherwise

HUSM = amount of household benefit per month (divided by 100) in 1987

HUSA = yearly amount of household benefit (divided by 1000) in 1987

HUSN = number of months of household benefit in 1987;

WEL1 = 1 if family received social assistance benefit in 1987
 = 0 otherwise

WEL2 = 1 if it is maintenance assistance benefit
 = 0 otherwise

WELN = months of maintenance benefits in 1987;

WELM = monthly amount of maintenance benefits in 1987;

WIL1 = 1 if household received special cases assistance benefit in year 1987;
 = 0 otherwise

WILN = months of special benefits in 1987;

WILM = monthly amount of special benefits in 1987;

KID1 = 1 if family received Kindergeld (benefits for children) in 1987
 = 0 otherwise

KIDN = number of children for whom received children benefits in 1987;

KIDM = monthly amount of child's benefits in 1987 (for

all children);

KIDA = (KIDM/12)/100, yearly child's benefits;

GRATS = 1 if attendance of school by children is free;
= 0 otherwise;

COSTM = monthly cost of school/day care facility for all
children in the family:
= 1 , 1-50
= 2 50-100
= 3 100-200
= 4 200-300
= 5 300-400
= 6 400-420

DH51 = family net income (including wife's wage) referred to
last month 1987 interview;

DSTELL = code for position in the family, women included in
our sample have all position 2 (=spouse of head of the
family).

APPENDIX II

TABLES

LIST OF TABLES

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TAB.6.4 - DESCRIPTIVE STATISTICS ON THE SUBSAMPLE

VARIABLES	MEAN	STANDARD DEV.
AGE WOMAN	40.99	7.83
AGEH (age husbands)	44.14	8.35
Number of children in the family in 1986 (NKID86)	0.93	1.02
NKID87	0.92	1.01
NKID88	0.90	1.00
EXP83(°)	0.53	0.50
EXP84(°)	0.54	0.50
EXP85(°)	0.54	0.50
EXP86(°)	0.56	0.50
EXP87(°)	0.57	0.50
PAR84(°)	0.50	0.50
PAR85(°)	0.52	0.50
PAR86(°)	0.51	0.50
PAR87(°)	0.53	0.50
PAR88(°)	0.54	0.50
PAR87F(°)	0.22	0.40
PAR87P(°)	0.31	0.44
WORK86(°)	0.51	0.18
WORK88(°)	0.54	0.13
EDUC (years of schooling of married women in the sample)	10.97	2.44

	mean	standard dev.
EDUCH (years of schooling of husbands of married women in the sample)	12.23	2.94
PAR87H(°)	0.94	0.24
HUNOCC(°)	0.03	0.17

(°) As we have discussed in the text we have used different measures to express employment status of married women in the sample. Apart from WORK86 which is a cohort constructed measure of past work experience all the other variables used above refer to the individual interviewed. PAR84 (and other PAR** variables) are equal to one when the woman was working in week preceding 1984 interview. EXP84 is equal to one if the woman interviewed has been working sometime during 1984. PAR87H is equal to 1 if the husband was working in week preceding 1987 interview and HUNOCC is equal to 1 if he was unemployed during week preceding 1987 interview.

TAB.6.5.A - EMPLOYMENT RATES IN WEEK PRECEDING INTERVIEW BY COHORT										
empl.rates	1984		1985		1986		1987		1988	
cohort	%	n	%	n	%	n	%	n	%	n
1958-1962	49.5	49	48.5	48	49.5	49	49.5	49	46.5	46
1953-1957	45.5	86	46.0	87	47.1	89	48.1	91	50.8	96
1948-1952	45.9	106	53.3	123	51.9	120	53.7	124	56.3	130
1943-1947	49.5	91	52.7	97	51.1	94	57.1	105	57.6	106
1938-1942	52.5	146	52.9	147	52.9	147	53.2	148	51.4	143
1933-1937	53.7	101	56.9	107	53.7	101	53.7	101	55.3	104

TAB.6.5.B - EMPLOYMENT RATES IN YEAR OF INTERVIEW BY COHORT										
empl.rates	1983		1984		1985		1986		1987	
cohort	%	n	%	n	%	n	%	n	%	n
1958-1962	60.6	60	54.6	54	54.5	54	57.6	57	57.6	57
1953-1957	53.4	101	49.2	93	49.2	93	51.8	98	55.6	105
1948-1952	51.1	118	55.0	127	55.0	127	57.1	132	59.7	138
1943-1947	50.5	93	53.8	99	53.8	99	57.6	106	62.5	115
1938-1942	52.5	146	54.0	150	54.0	150	55.8	155	53.6	149
1933-1937	56.9	107	56.0	105	55.8	105	56.9	107	55.8	105

**TAB.6.6 - EMPLOYMENT RATES IN WEEK PRECEDING 1987
INTERVIEW BY TYPE OF EDUCATION**

	%	n
Realschule (Real)	54.48	152
Intermediate (Fach)	57.14	16
Abitur (Abit)	58.11	43
University (UNIV)	68.18	30
General Vocational Training (Beruf)	53.91	62
Technical College (FACHO)	60.87	14
Specialized Technical Training (Fachu)	48.48	16
Apprenticeship (Lehre)	53.00	318
Civil Servant Training (CIV)	40.91	9
Public Health School (PUB)	65.45	36
BRLE (Beruf+Lehre)	53.10	361
ABFA (ABIT+FACH)	57.84	59
UNFA (Univ+Facho)	65.15	43

**TAB.6.7.A - EMPLOYMENT RATES IN WEEK PRECEDING 1987
INTERVIEW BY AGE OF THE YOUNGEST CHILD FOR MARRIED
WOMEN (PAR87) AND THEIR HUSBANDS (PAR87H)**

	PAR87	PAR87H
AGE OF THE YOUNGEST CHILD IN THE FAMILY		
less or equal 1	0.34	0.97
from 2 to 3	0.39	0.98
from 4 to 5	0.44	0.95
from 6 to 10	0.48	0.95
from 11 to 15	0.48	0.98

**TAB.6.7.B - EMPLOYMENT RATES IN WEEK PRECEDING 1987
INTERVIEW BY NUMBER OF CHILDREN IN THE FAMILY FOR
MARRIED WOMEN (PAR87) AND THEIR HUSBANDS (PAR87H)**

	PAR87			PAR87H	
NUMBER OF CHILDREN AGED LESS THAN 15 IN THE FAMILY	n	m.w.*employed	%	n	%
0	544	335	0.62	490	0.90
1	268	135	0.50	259	0.97
2	280	121	0.43	272	0.97
3	66	26	0.39	62	0.94
4	9	1	0.11	9	1.00
5	1	0	0.00	1	1.00
6	1	0	0.00	1	1.00

* number of married women (total in each group and employed amongst those groups)

**TAB. 6.8.a - EMPLOYMENT RATES IN WEEK PRECEDING 1987
INTERVIEW BY DEGREE OF IMPEDIMENT OF HEALTH IN
CARRYING OUT DAY-TO-DAY ACTIVITIES**

	%	n
NO IMPEDIMENT	50.4	389
LITTLE IMPEDIMENT	60.1	196
SUBSTANTIAL IMPEDIMENT	45.6	31

**TAB. 6.8.B - EMPLOYMENT RATES IN WEEK PRECEDING 1987
INTERVIEW BY HEALTH STATUS OF WOMEN INTERVIEWED**

	%	n
PERSON INTERVIEWED SUFFERED FOR AT LEAST ONE YEAR OR CHRONICALLY FROM SPECIFIC COMPLAINTS OR ILLNESS	52.6	180
PERSON INTERVIEWED DID NOT SUFFER FOR AT LEAST ONE YEAR OR CHRONICALLY FROM SPECIFIC COMPLAINTS OR ILLNESS	53.0	438

**TAB. 6.8.C - EMPLOYMENT RATES IN WEEK PRECEDING 1987
INTERVIEW BY HEALTH STATUS OF WOMEN INTERVIEWED**

	%	n
PERSON INTERVIEWED HAS BEEN OFFICIALLY CERTIFIED AS HAVING A REDUCED CAPACITY TO WORK OR BEING SEVERELY HANDICAPPED	56.4	31
OTHERWISE	52.7	587

**TAB.6.9 - EMPLOYMENT RATES IN WEEK PRECEDING 1987
INTERVIEW OF WOMEN BY THEIR HUSBANDS' EMPLOYMENT
STATUS IN WEEK PRECEDING 1987 INTERVIEW**

	% (*)	n
Husband's employment status		
- employed	52.6	576
- unemployed	48.6	17
- full-time employed	52.4	570
- part-time employed	100.0	2
- irregular or casual employed	100.0	4
- not in the labour force	56.0	42
- manual worker	53.5	212
- self-employed	76.2	93
- clerk	45.8	186
- public sector employee	50.0	85

(*) percentages computed as follows: (employed women married to husband in 'i-th' employment position/total number of women married to husband in 'i-th' employment position)*100

**TAB.6.10 - EMPLOYMENT RATES OF MARRIED WOMEN IN THE
SAMPLE IN WEEK PRECEDING 1987 INTERVIEW BY NUMBER OF
INHABITANTS IN THE METROPOLITAN AREA WHERE WOMEN'S
FAMILIES LIVE**

	%	n
NUMBER OF INHABITANTS		
less than 2,000	38.1	16
from 2,000 to 5,000	46.6	34
from 5,000 to 20,000	49.4	88
from 20,000 to 50,000	46.5	60
from 50,000 to 100,000	37.3	22
from 100,000 to 500,000	38.9	35
more than 500,000	51.8	28

**TAB.6.11 - EMPLOYMENT RATES OF MARRIED WOMEN IN THE
SAMPLE IN WEEK PRECEDING 1987 INTERVIEW BY BUNDESLAND
WHERE WOMEN'S FAMILIES LIVE**

	%	n
Bundesland where family lives		
Berlin	71.4	10
Schleswig-Holstein	51.7	15
Hamburg	60.0	3
Niedersachsen	56.9	41
Bremen	75.0	3
Nordrhein - Westfalen	35.2	63
Hessen	48.3	28
Rheinl-Pfalz, Saarl	25.6	11
Baden-Wuerttemberg	45.1	46
Bayern	52.9	63

TAB. 6.12.a - PRESENCE OF CONSTRAINTS ON DESIRED HOURS OF WORK		
	%	n
DESIRED HOURS OF WORK>ACTUAL HOURS OF WORK	10.1	118
DESIRED HOURS OF WORK<ACTUAL HOURS OF WORK	22.4	262
DESIRED HOURS OF WORK=ACTUAL HOURS OF WORK	67.5	789

TAB. 6.12.b - PRESENCE OF CONSTRAINTS ON DESIRED HOURS OF WORK BY COHORT				
		DES.HOURS>ACTUAL HOURS		
DES.HOURS<ACTUAL cohort	n	%	n	%
1958-1962	13	11.02	18	6.87
1953-1957	16	13.56	38	14.50
1948-1952	27	22.88	50	19.08
1943-1947	20	16.95	46	17.57
1938-1942	31	26.27	60	22.90
1933-1937	11	9.32	50	19.08
	118	100.00	262	100.00

TAB. 6.13 - PRESENCE OF CONSTRAINTS ON DESIRED HOURS OF WORK FOR PART-TIMERS

	%	n
DESIRED HOURS OF WORK>ACTUAL HOURS OF WORK	18.6	50
DESIRED HOURS OF WORK<ACTUAL HOURS OF WORK	32.0	86
DESIRED HOURS OF WORK=ACTUAL HOURS OF WORK	49.4	133
TOTAL	100.0	269

Tab.6.14 - Why women have worked part-time in week preceding 1987 interview

Reasons given by interviewed women	n	%
Labour market constraints ⁽¹⁾	11	4.1
child rearing reasons ⁽²⁾	113	42.0
Other family reasons	66	24.5
Does not need to work more hours, sufficient income	49	18.2
Does not wish to work more hours, otherwise she would have less leisure time	62	23.0
Other reasons	8	3.0

(1) These reasons have been given by answering to specific questions in the interview. In this case she did want to work more hours but she cannot find a place.

(2) To raise up the children and educate them

Percentage computed on the total of married women in part-time employment 269 in 1987 (women could give more than one reason for their part-time working)

6.15.a - Gross hourly wages by sex and type of job for women employed in 1987				
Type of job	Women		Men	
	n	mean	n	mean
manual worker	145	12.6	448	22.5
public worker	28	24.2	185	26.4
clerk	290	16.6	436	27.7
self employed	47	14.3	103	24.3
All employed	510	15.8	1,172	25.2

6.15.b - Gross hourly wages by sex and type of job for women employed in part-time jobs 1987				
Type of job	Women		Men	
	n	mean	n	mean
manual worker	76	12.3	1	8.3
public worker	13	25.3	0	0.0
clerk	169	16.0	3	17.6
self employed	16	15.4	3	54.4
All employed	274	15.3	7	32.0

6.15.c - Gross hourly wages by sex and type of job for women employed in full-time jobs 1987				
Type of job	Women		Men	
	n	mean	n	mean
manual worker	55	14.0	443	22.6
public worker	14	23.9	185	26.4
clerk	106	17.9	432	27.9
self employed	18	12.6	99	23.5
All employed	193	16.7	1,159	25.3

6.16.a - Mean gross earnings by sex and type of job in 1987(+)

Type of job in 1987	1986		1987		1988	
	women	men	women	men	women	men
part-timers	1298	3379	1308	1857	1326	2854
full-timers	2616	3977	2694	4118	2943	4328
all employed	1755	3944	1762	4087	1854	4304

(+) deflated earnings base = 1985

6.16.b - Mean gross hourly wages by sex and type of job in 1987 (+)

Type of job in 1987	1986		1987		1988	
	women	men	women	men	women	men
part-timers	14.6	26.7	15.3	32.0	17.1	29.3
full-timers	18.6	26.5	16.7	25.3	21.6	28.6
all employed	16.3	26.3	15.8	25.2	18.8	28.6

(+) deflated gross wages base = 1985

**6.16.c - Women's earnings as a percentage of men's and
by type of job in 1987 (+)**

Type of job in 1987	1986 %	1987 %	1988 %
part-timers	38.4	70.4	46.5
full-timers	65.8	65.4	68.0
all employed	44.5	43.1	43.1

(+) earnings have been deflated by using as base 1985.

**6.16.d - Women's gross wages as a percentage of men's
and by type of job in 1987 (+)**

Type of job in 1987	1986 %	1987 %	1988 %
part-timers	54.7	47.8	58.4
full-timers	70.2	66.0	75.5
all employed	62.0	62.7	65.7

(+) gross wages have been deflated by using as base 1985.

6.18.a - Mean gross monthly earnings for working married women in the sample years 1986, 1987, 1988 by cohort (+)						
cohorts	1986		1987		1988	
	n	mean	n	mean	n	mean
1958-1962	41	1717	38	1529	40	1685
1953-1957	74	1800	77	1738	77	1769
1948-1952	102	1706	101	1756	102	1809
1943-1947	77	1936	88	1956	86	2023
1938-1942	114	1739	122	1804	116	2089
1933-1937	79	1648	85	1632	80	1559

(+) deflated earnings base = 1985

6.18.b - Mean gross hourly wages for working married women in the sample years 1986, 1987, 1988 by cohort (+)						
cohorts	1986		1987		1988	
	n	mean	n	mean	n	mean
1958-1962	41	13.5	38	12.9	40	32.5
1953-1957	74	18.8	77	17.0	77	20.0
1948-1952	102	14.9	101	16.3	102	18.2
1943-1947	77	15.8	88	16.9	86	16.6
1938-1942	114	17.3	122	16.1	116	18.3
1933-1937	79	16.3	85	14.1	80	14.4

(+) deflated gross wages base = 1985

6.19.a - Gross hourly wages by sex and level of education for employed in 1987				
Years of education	Women		Men	
	n	mean	n	mean
8	119	13.6	102	25.7
10	12	15.3	5	23.6
11	212	14.7	638	21.2
12	117	17.6	187	27.3
13	1	9.7	2	25.2
14	7	14.1	23	25.7
15	7	21.2	25	37.1
17	13	22.6	64	33.3
19	23	24.6	127	35.8

6.19.b - Gross hourly wages by sex and level of education for part-timers women in 1987				
Years of education	Women		Men	
	n	mean	n	mean
8	64	13.5	1	8.3
10	6	12.6	0	0.0
11	118	14.3	2	18.4
12	65	17.0	1	60.0
13	1	9.7	0	0.0
14	5	12.7	0	0.0
15	1	15.0	1	25.0
17	3	22.6	0	0.0
19	12	26.7	2	47.1

6.19.c - Gross hourly wages by sex and level of education for full-timers women in 1987				
Years of education	Women		Men	
	n	mean	n	mean
8	49	14.4	100	26.0
10	6	18.0	5	23.6
11	71	15.2	632	21.3
12	46	17.8	185	27.2
13	0	0.0	2	25.2
14	1	26.3	23	25.7
15	4	30.1	24	37.6
17	7	22.4	64	33.3
19	9	23.1	125	35.6

TAB.6.20 - TYPE OF JOB IN WEEK PRECEDING 1987
INTERVIEW BY SEX

	WOMEN (°)		MEN (°°)	
	%	n	%	n
MANUAL WORKERS	28.3	140	36.2	396
CLERK	58.0	287	11.2	122
PUBLIC SECTOR EMPLOYEE	5.5	27	37.1	406
SELF-EMPLOYED	8.1	40	15.5	170

(°) percentage computed on total number of women employed in the sample;

(°°) percentage computed on total number of men employed in the sample;

Tab.6.21 - Consumers Price Indices for West Germany
used to deflate earnings and wages in some of the
previous tables(°)

Years	Price Index
1983	95.8
1984	98.0
1985	100.0
1986	99.8
1987	99.9
1988	101.0
1989	103.9

(°) Source: STBA, Statistisches Jahrbuch, 1990, p.548

CHAPTER 7 - EARNINGS AND WAGES MOBILITY FOR MARRIED WOMEN AND MEN IN WEST GERMANY

Introduction

In the wage-experience dynamic model of female labour supply presented in Chapter 4 we have relaxed the assumption of intertemporal separability of the lifetime budget constraint by assuming that current wages are affected by past work experience. This assumption can be tested directly by the estimation of the wage equation carried out in Chapter 8 for the U.K. and in Chapter 9 for West Germany. However, the assumption that past work experience has a significant effect on the current level of wages has also an implication for wages mobility. Namely, we expect wages mobility to differ across people characterized by a discontinuous work-profile and people continuously at work, because of seniority or because of human capital accumulation.

Therefore in this Chapter we analyse the wages and earnings mobility of West German married women in our sample according to their work-profile behaviour during the five waves of the German Panel (Section 7.3). We are aware of only another study on earnings mobility which analyses the effect of considering also people with quits and reentries in their work histories, the one by Creedy (1976) performed on British data for adult males.

Difficulties arise in the analysis of wages mobility since, as we mention in Section 7.1, the wage variable is not directly provided by the German Panel and the measure that we obtain for hourly wages is exposed to measurement errors which make the analysis of wages mobility less reliable. Therefore in this Chapter we have given more attention to the analysis of earnings (variable directly measured in the Panel data used) mobility. We are aware that also by using earnings we incur into problems, in fact, on the basis of earnings mobility analysis, one cannot state whether a decrease in earnings between two periods is due to a

drop in hourly wages or to a decrease in the hours of work supplied.

Since married women's work-profile, as shown in Chapter 5, is more likely to be interrupted than the one of their husbands, we have also compared earnings mobility of married women with earnings mobility of their husbands. This forms the subject of Section 7.4.

Apart from the aim of indirectly testing our theoretical model of female labour supply, the analysis of wages and earnings mobility for German married women gives us the possibility to have more information on women's earnings mobility. This is a subject which, as Atkinson, Bourguignon and Morrisson (1991) in their review paper stress, has been rarely investigated. Moreover, we are aware of only one study on the earnings profile over the life cycle of West German workers of either sex: the one by Schmahl (1983,1985) based on social security data from 1925 to 1974. Therefore the subject of the empirical analysis of this chapter has considerable interest in its own right.

The different measures of wages and earnings mobility used are described in section 7.1. Section 7.2 describes the sample of married women and their husbands. Section 7.5 contains some concluding remarks.

Section 7.1 - Measures of earnings mobility

One can choose amongst different methods to measure earnings or wages mobility. A detailed analysis of the measures and of the different statistical models of earnings dynamics can be found in Atkinson, Bourguignon and Morrisson (1991).¹

We have started the analysis on earnings and wages mobility by means of transition matrices where we have classified the women or men in our sample according to whether their gross real earnings (or wages) changed from 1984 to 1988. This method gave us a first indicator on how different groups of women may differ in upward or downward earnings (or wages) mobility. One can state that the different groups considered significantly differ as far as gross real earnings (or wages) mobility is concerned if the Chi-square statistics (which tests the significance of the difference amongst groups) for each transition matrix is higher than the critical value of Chi-Square at 5% level of significance.

Transition matrices and Chi-square tests give us information on how different groups of the sample differ in their earnings and wages dynamics. However, they do not provide us a measure on the strength of the relationship existing between earnings (or wages) in period t and earnings (or wages) in previous years. In order to analyse the type of relationship existing for each sub-group between earnings (or wages) at time t and earnings (or wages) at time $t+k$ we need to use other measures like correlation and regression coefficients which give us a measure of the linear relationship between earnings (or wages) in different years.

The Pearson Correlation Coefficient shown below measures the linear relationship existing between earnings (or wages) at time t and earnings or wages at time $t+k$.

$$\rho_{t,t+k} = \text{cov}(e_{i,t}, e_{i,t+k}) / \sigma_e(t) \sigma_e(t+k)$$

¹ Thereafter we will refer to Atkinson, Bourguignon and Morrisson's (1991) paper as to ABM.

where:

$\sigma_e(t)$ = standard deviation of earnings at time t

$\sigma_e(t+k)$ = standard deviation of earnings at time t + k

$e_{i,t}$ = earnings of woman i at time t

The correlation coefficient is an inverse measure of the degree of earnings mobility between period t and period t+k. The lower is ρ the greater is the mobility between earnings of the two periods considered, the lower is ρ the higher is σ and therefore the higher is income inequality.²

The Standard Error for the correlation coefficients increases the lower is the number of observations. If, consistently with the formula presented below one ignores the higher order terms, the Standard error is:

$$\text{Standard Error for } \rho = (1-\rho^2) \{1/n + 11/\rho^2/(2n^2)\}^{1/2}$$

We expect two things: 1) the value of the correlation coefficient between earnings in two different periods will decrease the longer is the time interval between the two observations of earnings, i.e. we expect earnings (or wages) mobility to be higher the longer is the time interval considered; 2) there will be more mobility for persons with interruptions in their employment history.

The Socio-economic Panel provides data on individual earnings for the different waves, and we can use the information for the individuals who were continuously working and continuously took part to the interview from 1984 to 1988 in order to test the hypothesis of change in the correlation coefficient with the length of the time interval and compare these results to the ones

² The standard deviation of the log of earnings can be used as a measure of income inequality.

for people with discontinuous work profile to check whether the latter have higher earnings mobility. We can then compare our results with the analysis of Hart (1976, p.557) based on a sample of British working men, which shows that the value of the correlation coefficient tends to decrease with increases in the time interval.

Another topic of this analysis on earnings and wages mobility is how mobility changes with the cohort of the interviewed workers. We expect younger workers to be in a less stable position in the labour market and therefore to have higher earnings and wages mobility than the older workers. The data base that we use allows us to classify the sample in cohorts, to compute correlation coefficients for the different age groups and to test this hypothesis both for women and for men. For this purpose, we have divided the sample in 10 year cohorts.³ The analyses of Thatcher (1971) and Hart (1976) on British working men pointed out how the correlation coefficient increases with ages, showing a higher wage mobility between ages 20 and 30 and a lower mobility for older men.

Turning to wages, we want to measure wages mobility and also we need an indirect test for our theoretical model on the effect of a broken work-profile on current level of wages. However the German Panel directly provides only the value of gross monthly earnings and does not directly provide the value of hourly wages for the individual. Therefore we have to compute hourly gross wages by dividing monthly gross earnings by the actual hours of work performed in the week preceding the interview times four. The measures of wages mobility are therefore exposed to the problem of measurement errors from two sources: since one should take into

³ We have not considered 5-year cohorts groups. In fact, given the low number of observations for each cohort, as shown in the formula mentioned above in the text, the Standard errors of the correlation coefficients would have sharply increased therefore lowering the precision of the obtained estimates.

account measurement errors in earnings and also measurement errors in hours of work. One should also take into account that we assume that the individual's weekly hours of work stay the same over the last month.

Therefore, even if for our analysis wage mobility is of a greater interest, we will devote more attention to the analysis of gross monthly earnings (which are directly provided by the Panel Data) mobility. However we should notice that also the latter analysis is exposed to problems. In fact, it is difficult to distinguish between a change in earnings due to changes in hourly wages and a change in earnings due to a change in hours of work. For instance, downward earnings mobility experienced by a woman with a discontinuous work-profile when she returns to work can arise either because her hourly wage rate decreases or because her hours of work decrease (and the latter occurs if for instance she changes from full-time to a part-time job after the interruption). The latter phenomenon is very likely to occur for married women with a discontinuous work-profile as we have shown in Chapter 5 and 6.

The analysis of earnings mobility based on correlation coefficients and on transition matrices does not give us an estimate of the size of the change occurred in earnings between two different periods and does not provide us with the possibility to carry out prediction on the value of earnings in period $t+k$ once we have the knowledge of the value of earnings in previous periods. In order to do so and in order to have information on earnings (or wages) dynamics over the period considered one needs the estimated regression coefficient for earnings (or wages), β

$$\log e_{t+k} = \alpha + \beta \log e_t$$

The value of the estimated β represents the effect of a change by one of earnings (or wages) in year t on earnings (or wages) in year $(t+k)$ and therefore differs from the value of the correlation

coefficient which measures the strength of the linear relationship between earnings (or wages) in year t and earnings (or wages) in year $t+k$. We can use regression analysis in order to predict a value for gross real earnings in year $(t+k)$ from a knowledge of earnings in previous years. ABM (1991) show how the regression coefficient can be used also to test the type of statistical model of earnings dynamics, for instance if β is significantly less than one, one can state that there is a regression towards the mean in a Galtonian sense. The survey by ABM (1991) on empirical analyses of earnings mobility shows how the regression and correlation coefficients differ, and we are going to compare these two different measures of mobility in the following sections.⁴

⁴ Refer to ABM (1991) for a detailed discussion on the different statistical models on earnings mobility. ABM (1991) found that the correlation coefficient is generally increasing with age, while the regression coefficient is hump-shaped, and that "mobility as measured by the regression coefficient does not appear to be increasing with the length of the period of observation, as was the case with the correlation coefficient."

Section 7.2 - Analysis of the samples used

The analysis on earnings and wages mobility is carried out on the same sample of West German married women that we use for the application of our dynamic model on female labour supply.⁵ The original sample is made up of 1,169 German married women aged from 25 to 54 in 1987, with spouse present over the 5 waves considered (from 1984 to 1988) who took part continuously in the Panel. We have divided this sample in two groups: the "constant sample" made up of those married women who stated that they were working during the *week preceding each year's interview* from 1984 to 1988 and a discontinuous sample made up of those married women who experienced a broken work profile from 1984 to 1988: they were working in week before 1984 interview and in week preceding 1988 interview but in between they were not working at least for one year. Married women falling in this last class were only 29 (a very small sample), while married women in the constant sample were 283. However, we should stress that women in the "constant" sample may as well have experienced an interruption in their career profile during the period considered apart from one week preceding each year's interview and may have a broken work-profile before 1984, so it is not to be considered a *truly constant sample*.

In the following section we investigate how wages and earnings mobility differ across these different groups. We expect that women who have experienced an interruption in their career in the period considered are more likely to be affected by downward mobility than women showing a continuous work-profile, because they are characterized by a lower seniority and by less human capital accumulation than those women showing a continuous work-profile.

⁵ Refer to Chapter 9 for the results of the application of our dynamic model of female labour supply to West German data and to Ch.6 for a detailed description of the sample used.

Since, as already discussed in Chapter 5, married women more frequently than men are characterized by a broken work-profile in their life cycle, we carry out a comparison of the earnings mobility of married women in our sample with the one of their husbands. In order to carry out this comparative analysis we have divided also the sample of husbands according to their work history into those who stated they were working during the week preceding each year's interview from 1984 to 1988 (the constant sample) and those who were working in week before 1984 interview and in week preceding 1988 interview but in between they were not working at least for one year (the discontinuous sample). Only 27 married men belong to this last group, while the constant sample is made up of 828 married men. So for both men and women in the discontinuous sample we face all the statistical problems connected to the existence of a small sample size. As we have stressed for the married women's constant sample, one should notice that also the married men in the "constant sample" may have experienced interruptions in their work-profile, so it is not a truly constant sample.

Section 7.3 - Earnings and Wages mobility for married women

In this section we will analyse gross real earnings and wages mobility of married women by taking into account the different measures of mobility described in Section 7.1. Gross earnings and gross wages have been deflated by using Consumers Price Indices and by taking 1984 as the base year.⁶

⁶ Source of the price indices is STBA, Statistisches Jahrbuch, 1990, p.548. All tables in this Chapter have been obtained by our computations on the German SocioEconomic Panel various waves.

7.3.1 - Gross earnings mobility according to the career pattern of married women in our sample

In order to have a first idea on how different groups of women differ in their earnings mobility we start by analysing the transition matrices presented in Tab.7.1.a below which refers to earnings mobility from 1984 to 1988.

Tab.7.1.a - Gross earnings mobility, married women in the constant sample and in the discontinuous sample

	downward mobility		upward mobility		Total
	%	obs.	%	obs.	obs.
discontinuous sample	44.83	13	55.17	16	29
constant sample	15.90	45	84.10	238	283

Chi-Square statistics for the difference between the two groups of married women in the sample:

	D.F.	Value	Critical value of	Probability
			Chi-square	
			$\alpha = 0.05$	
Chi-Square	1	14.54	3.84	0.0001

As the above Table shows, downward earnings mobility from 1984 to 1988 is higher amongst married women in the "discontinuous" sample than amongst married women in the constant sample. In fact around 45% of women with a broken work profile experienced downward earnings mobility between 1984 and 1988 against 16% for the constant sample. The Chi-square test performed in Tab.7.1.a shows that the value for the computed Chi-square (14.54) is higher than the critical value (3.84) at 0.05

level of significance and this leads us to reject the null hypothesis (of no difference between the two populations) at 0.05 level of significance.⁷ Therefore we can state that a woman with a discontinuous work-profile has a statistically significantly different earnings mobility pattern than women showing a continuous work-profile in the period considered. We cannot of course conclude that the higher downward earnings mobility experienced by women in the discontinuous sample is due to downward mobility in wages, since downward earnings mobility may also arise because of a drop in the hours of work supplied. And the latter is very likely to occur given the higher probability for married women with a discontinuous work profile to return to a part-time (rather than to a full-time) job after the interruption.

The transition matrices reported in Tab.7.1.b and 7.1.c in the Appendix to this Chapter show how gross real earnings mobility from 1984 to 1988 does not significantly differ across cohorts (at 0.05 significance level) for both the constant and the discontinuous sample. For all the subgroups considered the probability of experiencing upward gross earnings mobility is higher for older cohorts, probably because of seniority. However, we should stress that the cohort analysis, especially for the discontinuous sample, is difficult given the small sample sizes.⁸

7.3.2 - Analysis of correlation between earnings in 1988 and earnings in previous years

One of the main snags of the measures on mobility based on wages is that they are more likely to be affected by measurement errors than those based on gross earnings as we have already discussed in Section 7.1.

⁷ The null hypothesis can be rejected also at 0.01 and 0.005 levels of significance.

⁸ Tab.7.7.a and Tab. 7.7.b in the Appendix show how the degree of inequality of earnings measured by the standard deviation of them is increasing (apart from women in the 1943-1952 birth cohort) for the discontinuous sample (i.e. for those women with an interrupted workprofile) while it does not follow a clear pattern for women having a continuous workprofile from 1984 to 1988.

This is why, in analysing mobility, we continue by studying earnings mobility in this Section.

The first measure of gross earnings mobility that we consider is the correlation coefficient of earnings in 1988 and earnings in previous years (Tab.7.2.a and 7.2.b).

Tab.7.2.a - Gross earnings mobility, married women in the constant sample correlation coefficients year 1988 with other years

	correlation	prob.level	S.E. ⁹
1984	0.83	0.0001	0.019
1986	0.92	0.0001	0.009
1987	0.95	0.0001	0.006

⁹ In this, as in other tables, the Standard error for the correlation coefficient has been computed by using Hotelling formula:

Standard Error for $\rho = (1-\rho^2) \{1/n + 11/\rho^2/(2n^2)\}^{1/2}$
 where n= sample size; ρ = correlation coefficient

GRAPH 7.1: Gross earnings mobility for married women in the constant sample

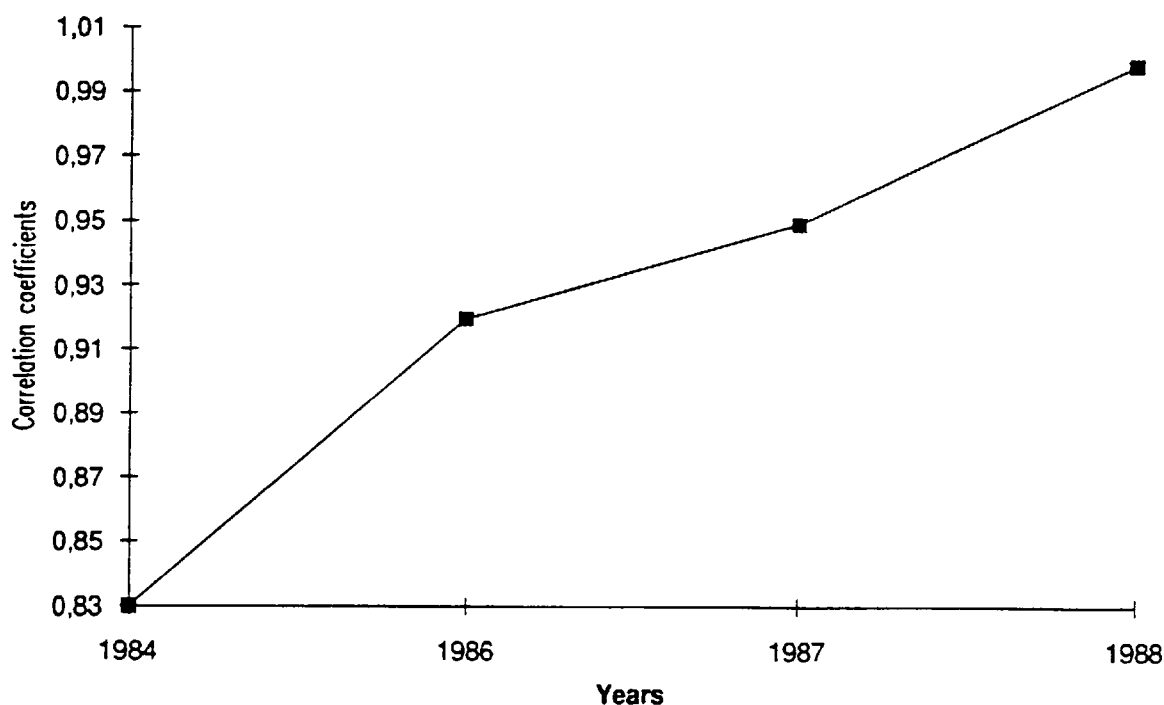


Table 7.2.a and Graph 7.1 show how correlation coefficients change with the time interval for the constant sample. One result, in line with previous literature findings, is that the correlation coefficient is higher (and therefore mobility is lower) the shorter is the time interval (in fact as one can see from Tab.7.2.a the correlation coefficient between 1988 and 1984 is 0.83 significantly lower, at 0.05 level, than 0.95, the correlation coefficient between 1988 and 1987).¹⁰ However, one should notice that the sizes of the coefficients obtained by our analysis are different and not directly comparable (given the different samples used) to the ones produced by the other analyses on correlation coefficients over time which are based on samples of male workers or restricted to given types of professions.¹¹

¹⁰ For the statistical test of hypothesis refer to Appendix II in this Chapter.

All the gross earnings correlation coefficients in Tab.7.2.a are significantly different from 0 and from 1 at 95% confidence level.¹² In this Table we have also corrected the Standard error following Hotelling formula.

Tab.7.2.b - Gross earnings mobility, married women in the discontinuous sample correlation coefficients year 1988 with 1984

	discontinuous sample n.=29		
	correlation	prob.level	S.E.
1984	0.60	0.0006	0.123

Married women with a discontinuous work profile have higher gross earnings mobility than women having a continuous work profile from 1984 to 1988. In fact the former have correlation coefficient between gross earnings in 1988 and gross earnings in 1984 of 0.60 which is significantly lower than 0.83 (the correlation coefficient of earnings for married women in the constant sample).¹³

Correlation coefficients between gross earnings in 1984 and in 1988 do not follow a precise pattern according to cohort groups of married women in the constant sample as Tab.7.3 shows.¹⁴

In Tab.7.3 we introduce new measures of mobility: correlation of log of earnings and regression coefficients.¹⁵ As one can see by analysing the

¹¹ For a survey of the latter refer to ABM (1991, pp.98-99).

¹² For the statistical test of hypothesis refer to Appendix II in this Chapter.

¹³ Refer to Appendix II in this Chapter for the statistical test on this hypothesis.

¹⁴ We do not present in the Appendix correlation coefficients by cohort for the discontinuous sample since the small number of observations makes the S.E. very high.

¹⁵ The advantages of a loglinear specification for wage equations have been commented by Nakamura and Nakamura (1985b, pp.245-246 and pp.272-274). Refer to ABM (1991) for a detailed analysis on the models on wages and earnings dynamics.

regression coefficients shown in Tab.7.3, in the Appendix I to this Chapter, they are not always less than one.¹⁶ This is in contrast with the Galtonian model of earnings dynamics.¹⁷

Differently from what ABM (1991) find, the logarithmic transformation decreases the size of correlation and regression coefficients for the constant sample (Tab.7.3 in Appendix I) therefore showing a higher mobility for logarithm of earnings than for their absolute value.

7.3.3 - Gross wages mobility according to the career pattern of married women in our sample and analysis of correlation between wages in 1988 and wages in previous years

We now turn to the analysis of wages dynamics. The analysis of wages mobility may control for the differences in earnings mobility between women in the continuous and in the discontinuous sample which can arise because of the higher probability for women with a discontinuous work profile to experience a switch towards part-time jobs or other changes in hours of work after reentering the labour market .

As Tab.7.4.a below shows wages mobility behaviour does not significantly differ (at 0.05 significance level) between the two sub-samples of married women analysed: the discontinuous and the constant sample.

¹⁶ For the older cohort the regression coefficient between earnings in 1988 and earnings in 1984 is significantly higher than 1 at 0.05 level of significance, as the test referred to in Appendix I shows.

¹⁷ On the other hand the regression coefficients of log of gross earnings in 1984 and 1988 are significantly lower than 1 for all the cohort groups.

Tab.7.4.a - Gross wages mobility, married women in the constant sample and in the discontinuous sample

	downward mobility		upward mobility		Total
	%	obs.	%	obs.	obs.
discontinuous sample	24.14	7	75.86	22	29
constant sample	25.44	72	74.56	211	283

Chi-Square statistics for the difference between the two groups of married women in the sample:

	D.F.	Value	Critical value of Chi-Square $\alpha = 0.05$	Probability
Chi-Square	1	0.024	3.84	0.878

Similarly the Chi-square test shows that gross wages mobility does not significantly differ across cohorts for the married women in our samples (see Tab.7.4.b and 7.4.c in the Appendix I to this Chapter).

As we have already mentioned in Section 7.1, measures on wages mobility are more exposed to measurement errors than measures on gross earnings mobility. The correlation coefficients for gross hourly wages that we report in Tab.7.5.a and 7.5.b are much lower than the correlation coefficients for gross earnings and show higher mobility for wages than for monthly earnings over the period considered.¹⁸

¹⁸ This is in contrast with what ABM (1991) find by comparing hourly and weekly earnings.

Tab.7.5.a - Gross wages mobility, married women in the constant sample correlation coefficients year 1988 with other years

constant sample n: 283			
	correlation	prob.level	S.E.
1984	0.15	0.01	0.058
1986	0.08	0.17	0.059
1987	0.26	0.0001	0.055

Tab.7.5.b - Gross wages mobility, married women in the discontinuous sample correlation coefficients year 1988 with 1984

discontinuous sample n.=29			
	correlation	prob.level	S.E.
1984	-0.03	0.88	0.19

The correlation coefficients for the constant sample are all significantly smaller than 1 at 0.05 level. But, differently from what we have found for earnings, one cannot find a decreasing trend in wages mobility the shorter is the time interval.

Wages mobility is higher for women in the discontinuous than for women in the constant sample but this difference is not significant at 0.05 level.¹⁹

On the whole, by comparing the correlation coefficients of gross earnings and hourly wages one can see how the latter are less significant (in fact the probability value associated with the hypothesis of null correlation between wages of different years is generally higher than for the gross earnings correlation coefficients).

Turning to wages mobility across cohorts (Tab.7.6 in Appendix I) one can see how married women in older cohorts are the ones having lower wages mobility as the correlation coefficients of the logarithm of gross wages show.

¹⁹ Refer to Appendix II for statistical tests.

As one can see by comparing the correlation and regression coefficients for absolute and logarithm of wages (Tab.7.6 in the Appendix) the logarithmic transformation makes the correlation and regression coefficients higher for wages for each cohort in the constant sample. This is in line with the results stressed by ABM (1991) and it is in contrast with what we have found for earnings.

7.3.4 - Earnings and wages mobility for West German Married women: a Summary

One conclusion that one may draw from this first analysis is that married women having a broken work profile are less likely than continuously working women, to experience an increase in their earnings when they go back to work, as the transition matrices referred to in Section 7.3.1 show. Moreover, for married women with a broken work-profile, gross earnings are significantly more transitory than those of women in the constant sample.

However, this may be due to the higher probability for women in the discontinuous sample to experience a switch towards part-time employment when they return to work.

As shown in Section 7.3.2, the longer is the time interval the higher is gross earnings mobility for married women in the constant sample, and this result is in line with previous findings on men's earnings mobility.

The lack of detailed data on earnings and wages for years before the first interview in 1984, makes it impossible to go further back in order to divide the sample between married women who were continuously working since their first job, and married women who experienced one or more interruptions in their life cycle work profile. Actually we expect the latter to be the predominant case for the sample of married women that we have analysed so far. In the following section we carry out a comparison of married women's real earnings mobility with that of their

husbands: a group of people who are more likely to have a continuous work-profile over their life cycle.

Section 7.4 - Comparison of earnings mobility of married women and their husbands in our sample.

As we have done for married women, we have classified the sample of husbands in two groups: one, made up of 828 men, of men who stated that they were working during the week preceding each interview from 1984 to 1988 (the "constant" sample, though as already stressed above this is not to be considered as a truly constant sample) and the other (made up of 27 men) with men who had a broken work profile from 1984 to 1988 (the discontinuous sample).

As we have found for the sample of married women (Tab.7.1.a), gross earnings mobility significantly differs across the two sub-samples (the constant and discontinuous sample). In fact, as one can see from Tab.7.8.a below, the Chi-square statistics has a value of 29.89 against the critical value, at 0.05 level of significance, of 3.84.

Tab.7.8.a - Gross earnings mobility, married men in the constant sample and in the discontinuous sample

	downward mobility		upward mobility		Total
	%	obs.	%	obs.	obs.
discontinuous sample	44.44	12	55.56	15	27
constant sample	10.39	86	89.61	742	828

Chi-Square statistics for the difference between the two groups of married men in the sample:

	D.F.	Value	Critical value of Chi-Square $\alpha = 0.05$	Probability
Chi-Square	1	29.89	3.84	0.0001

The constant sample is characterized by a higher upward earnings mobility than the discontinuous sample. Moreover, by comparing the transition matrices for married women (in Tab.7.1.a) with the one of married men (Tab.7.8.a above) one can see how married men in the constant sample are characterized by a significantly higher probability of upward mobility in earnings over the period than are married women.²⁰

Turning to the analysis of the correlation coefficients for earnings the comparison of Tab.7.2.a and Tab.7.9.a and Graph 7.2 shows how the correlation coefficients between gross real earnings in 1988 and gross real

²⁰ By using a one tailed hypothesis test for the null hypothesis that the two proportions are equal against the alternative that the proportion of women characterized by upward earnings mobility is lower than those of men, one can reject the null in favour of the alternative at 0.05 level of significance since the calculated z (-2.30) is lower than -1.96.

earnings in 1984 are significantly higher for women than for their husbands at 0.05 level ²¹ and this suggests a lower gross earnings mobility for women than for men. This result is in line with previous evidence on British data surveyed by ABM (1991). On the other hand, gross earnings mobility of people in the discontinuous sample (Tab.7.9.b and 7.2.b) does not significantly differ according to sex (refer to Appendix II for test on this hypothesis), however, this may be due to the small sample sizes of both groups.

Table 7.9.a shows how correlation coefficients change with the time interval for the constant sample. All the gross earnings correlation coefficients in Tab.7.9.a are significantly different from 0 and from 1 at 95% confidence level.²²

²¹ For the statistical tests refer to Appendix II in this Chapter.

²² Refer to tests in Appendix II to this Chapter.

Tab.7.9.a - Gross earnings mobility, married men in the constant sample correlation coefficients year 1988 with other years

	correlation	prob.level	S.E. ²³
1984	0.79	0.0001	0.013
1986	0.80	0.0001	0.013
1987	0.83	0.0001	0.011

Tab.7.9.b - Gross earnings mobility, married men in the discontinuous sample correlation coefficients year 1988 with 1984

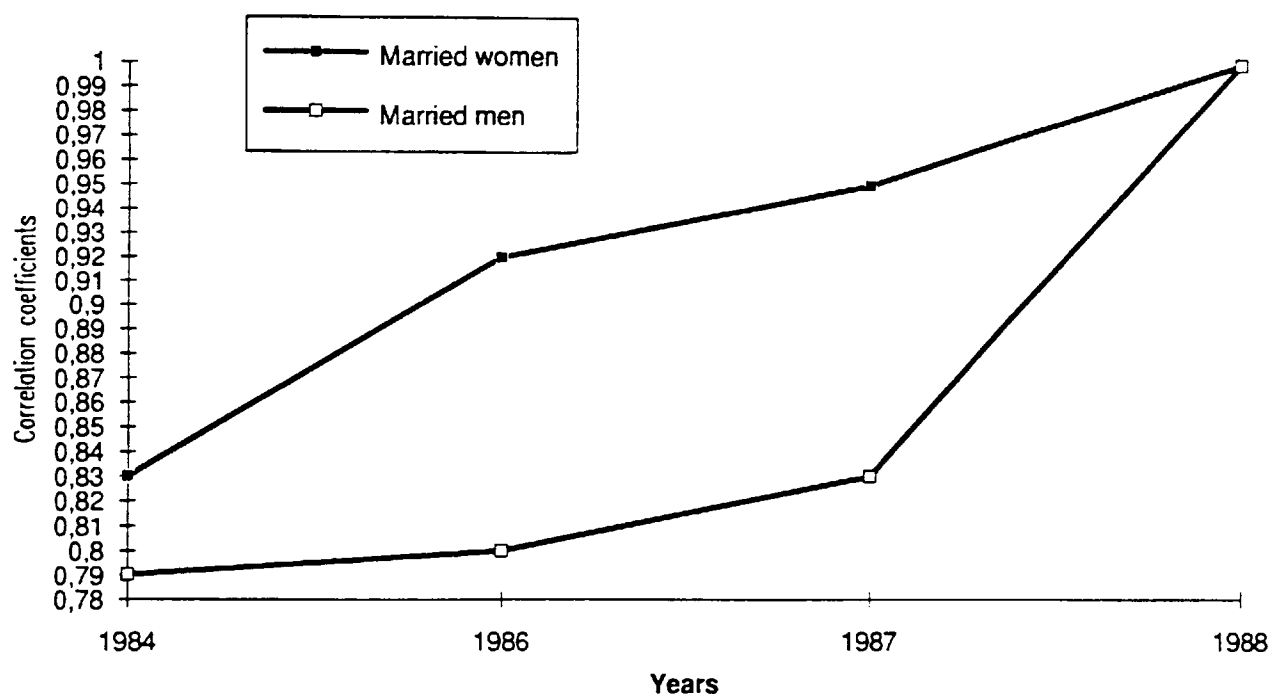
	discontinuous sample n.=27		
	correlation	prob.level	S.E.
1984	0.63	0.0005	0.121

Graph 7.2 compares the correlation coefficients of married women in the constant sample with those of their husbands in the constant sample. As we have found for married women (Tab.7.2.a) the correlation coefficient is significantly higher (and therefore mobility is lower) the shorter is the time interval (in fact as one can see from Tab.7.9.a the gross earnings correlation coefficient between 1988 and 1984 is 0.79, significantly lower than 0.83 the correlation coefficient between 1988 and 1987 at 0.05 level).²⁴ The change in the size of the correlation coefficients is not significantly higher for married women than for married men as the tests referred to in Appendix II show.

²³ In this, as in the other Tables, the Standard Error for the correlation coefficient has been computed by using Hotelling formula.

²⁴ For the statistical tests refer to Appendix II.

Graph 7.2: Gross earnings mobility for married women and married men in the constant sample



Turning to the analysis of gross earnings mobility across cohorts one can notice, in line with the findings of ABM (1991), that the correlation coefficients are increasing with age for married men, whereas they were hump-shaped for married women.²⁵

²⁵ This holds true for the constant sample (refer to Tables 7.3 - 7.10 in the Appendix). However the analysis of the transition matrices (Tabb.7.8.b, and 7.8.c in Appendix I to this Chapter) shows that gross earnings mobility does not significantly change across cohorts for married men.

Section 7.5 - Conclusions

In this Chapter we have tried to cast more light on the earnings and real wages dynamics in West Germany by using the German Socio-economic Panel.

One result which holds true both for married women and for their husbands is that their gross earnings mobility significantly differs according to their work profile. Transition matrices show that married women (or their husbands) having a broken work profile from 1984 to 1988 are generally less likely than women (or men) with a continuous work-profile to experience upward earnings mobility from 1984 to 1988. When we compare the constant sample of married women (who have a continuous work-profile from 1984 to 1988 but are significantly more likely than their husbands to have an interrupted work-history over their life cycle) with the sample of their husbands, we do find that men have a higher probability to have an increase in their real earnings from 1984 to 1988. These results are in line with one of the key features of our theoretical model on female labour supply: that current earnings are affected by past work experience and by this way that the assumption of intertemporal separability of the lifetime budget constraint must be relaxed. This should hold true also for married men, since the evidence on married men's earnings mobility provided in Section 7.4 shows that married men's earnings mobility differs according to whether they experienced interruptions in their work-profile or they showed a continuous work-profile. However, one should notice that the drop in real earnings may be due also to a switch from full-time to part-time employment or to a decrease in the hours of work supplied which people having an interrupted work history are more likely to experience when they return to work.

The results of our analysis on West German married women and their husbands' earnings mobility are consistent with previous

evidence on the subject. However, the comparison of our results on West German married women's earnings mobility with those of other countries is difficult given the scarcity of analyses on women's earnings mobility that also ABM (1991) in their survey on earnings mobility highlight. By comparing our results to the British figures referred to by ABM (1991) we can assert that, as in Great Britain also in West Germany gross earnings mobility is lower for married women than for their husbands.

Turning to West German married men in our sample we find that gross earnings mobility of those continuously working from 1984 to 1988 does not significantly differ from earnings mobility (expressed by the average correlation coefficient for adjacent years) of 1,144 white males head of the household who were continuously working from 1963 to 1973 found by Lillard and Willis (1978) in their analysis on USA data.

Another result consistent with previous evidence on men's earnings mobility²⁶ is that mobility increases with the time interval considered for both men and women in the constant sample.

²⁶ We refer to the study by Hart (1976, p.557) on British working men.

APPENDIX I

TABLES ON WAGES AND EARNINGS MOBILITY

All these tables have been obtained by our computations on the German SocioEconomic Panel Data, various waves.

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Tab.7.1.b - Gross earnings mobility by 10 years cohort, married women, constant sample (n.283)					
cohort	downward %	mobility obs.	upward %	mobility obs.	total obs.
1953-62	23.53	12	76.47	39	51
1943-52	15.74	17	84.26	91	108
1933-42	12.90	16	87.10	108	124
		Degrees of freedom	Value	Probability	
Chi-square		2	3.06	0.22	

Tab.7.1.c - Gross earnings mobility by 10 years cohort, married women, discontinuous sample (n.29)					
cohort	downward %	mobility obs.	upward %	mobility obs.	total obs.
1953-62	56.25	9	43.75	7	16
1943-52	50.00	3	50.00	3	6
1933-42	14.29	1	85.71	6	7
		Degrees of freedom	Value	Probability	
Chi-square		2	3.55	0.17	

Tab.7.3 - Gross earnings mobility by 10 years cohort, married women, constant sample (n.283)

cohort	correlation	coefficient	regression coeff.		n.obs
	grosse84-88	loge84-88	grosse84-88	loge84-88	
	prob.level	in brackets	t-ratio in brackets		
1953-62	0.87 (0.0001)	0.84 (0.0001)	1.05 (12.31) [0.59]	0.86 (10.67) [-1.74]**	51
1943-52	0.73 (0.0001)	0.65 (0.0001)	0.88 (10.85) [-1.48]	0.66 (8.72) [-4.49]**	108
1933-42	0.90 (0.0001)	0.83 (0.0001)	1.09 (22.21) [1.84]*	0.78 (16.68) [-4.70]**	124
total	0.83 (0.0001)	0.77 (0.0001)	1.01 (25.25) [0.25]	0.76 (20.07) [6.34]**	283

grosse84= gross earnings 1984

loge84= logarithm of gross earnings 1984

in square brackets t-ratio for the hypothesis that the regression coefficient (b) = 1

* = one can reject the null hypothesis that $b=1$, at 0.05 significance level, in favour of the alternative $b > 1$

** = one can reject the null hypothesis that $b=1$, at 0.05 significance level, in favour of the alternative $b < 1$, since the computed $t < -1.64$.

In the other cases one cannot reject the null that $b=1$

Tab.7.4.b - Gross Wage mobility by 10 years cohort, married women, constant sample (n.283)					
cohort	downward mobility %	mobility obs.	upward mobility %	mobility obs.	total obs.
1953-62	23.53	12	76.47	39	51
1943-52	25.00	27	75.00	81	108
1933-42	26.61	33	73.39	91	124
		Degrees of freedom	Value	Probability	
Chi-square		2	0.20	0.91	

Tab.7.4.c - Gross Wage mobility by 10 years cohort, married women, discontinuous sample (n.29)					
cohort	downward mobility %	mobility obs.	upward mobility %	mobility obs.	total obs.
1953-62	25.00	4	75.00	12	16
1943-52	33.33	2	66.67	4	6
1933-42	14.29	1	85.71	6	7
		Degrees of freedom	Value	Probability	
Chi-square		2	0.66	0.72	

Tab.7.6 - Gross Wage mobility by 10 years cohort, married women, constant sample (n.283)

cohort	correlation coefficient		regression coeff.		n.
	grossw84-88	logw84-88	grossw84-88	logw84-88	
	prob.level in brackets		t-ratio in brackets		
1953-62	0.19 (0.19)	0.22 (0.13)	0.03 (1.34) [-43.33]**	0.12 (1.54) [-11.29]**	51
1943-52	0.39 (0.0001)	0.40 (0.0001)	0.18 (4.39) [-20]**	0.35 (4.49) [-8.34]**	108
1933-42	0.06 (0.49)	0.41 (0.0001)	0.07 (0.69) [-9.17]**	0.44 (4.98) [-6.34]**	124
total	0.15 (0.0102)	0.35 (0.0001)	0.08 (2.59) [-29.78]**	0.29 (6.24) [-15.28]**	283

grossw84= gross wages 1984

logw84= logarithm of gross wages 1984

in square brackets t-ratio for the hypothesis that the regression coefficient (b) = 1

* = one can reject the null hypothesis that $b=1$, at 0.05 significance level, in favour of the alternative $b > 1$

** = one can reject the null hypothesis that $b=1$, at 0.05 significance level, in favour of the alternative $b < 1$ since the computed $t < -1.64$

In the other cases one cannot reject the null that $b=1$

Tab.7.7.a - Measures of logarithm of gross wage and gross monthly earnings by 10 years cohorts - married women constant sample

cohort		log of gross wage		log of gross earnings	
	years	mean	Standard Dev.	mean	St.deviation
1953	1984	2.60	0.86	7.29	0.67
-					
1962	1986	2.66	0.47	7.37	0.66
n=51	1987	2.59	0.37	7.40	0.65
	1988	2.69	0.46	7.44	0.69
1943	1984	2.66	0.60	7.34	0.61
-					
1952	1986	2.66	0.46	7.48	0.60
n=108	1987	2.75	0.42	7.55	0.59
	1988	2.78	0.52	7.56	0.62
1933	1984	2.58	0.45	7.26	0.66
-					
1942	1986	2.65	0.47	7.38	0.64
n=124	1987	2.68	0.38	7.43	0.61
	1988	2.69	0.48	7.44	0.62
all	1984	2.62	0.60	7.30	0.64
cohort	1986	2.65	0.47	7.42	0.63
n=283	1987	2.69	0.40	7.47	0.61
	1988	2.73	0.49	7.48	0.64

Tab.7.7.b - Measures of logarithm of gross wage and gross monthly earnings by 10 years cohorts - married women discontinuous sample

cohort		log of gross wage		log of gross earnings	
	years	mean	Standard Dev.	mean	St.deviation
1953	1984	2.77	0.50	7.45	0.68
-					
1962	1988	3.08	0.95	7.30	0.57
n=16					
1943	1984	2.38	0.65	6.87	0.72
-					
1952	1988	2.50	0.75	6.58	0.88
n=6					
1933	1984	1.87	0.51	6.23	1.01
-					
1962	1988	2.42	0.53	6.66	0.88
n=7					
all	1984	2.47	0.64	7.03	0.91
cohorts					
	1988	2.80	0.86	7.00	0.77
n=29					

Tab.7.8.b - Gross earnings mobility by 10 years cohort, married men, constant sample (n.828)					
cohort	downward mobility		upward mobility		total
	%	obs.	%	obs.	obs.
1953-62	12.14	17	87.86	123	140
1943-52	11.72	30	88.28	226	256
1933-42	8.64	26	91.36	275	301
other	9.92	13	90.08	118	131
Chi-square		Degrees of freedom		Value	Probability
		3		1.97	0.58

Tab.7.8.c - Gross earnings mobility by 10 years cohort, married men, discontinuous sample (n.27)					
cohort	downward mobility		upward mobility		total
	%	obs.	%	obs.	obs.
1953-62	50.00	3	50.00	3	6
1943-52	37.50	3	62.50	5	8
1933-42	50.00	6	50.00	6	12
other	0	0	100.00	1	1
Chi-square		Degrees of freedom		Value	Probability
		3		1.18	0.76

Tab.7.10 - Gross earnings mobility by 10 years cohort,
married men, constant sample (n.828)

cohort	correlation grosse84-88	coefficient loge84-88	regression coeff. grose84-88 loge84-88		n.
	prob.level in brackets		t-ratio in brackets		
1953-62	0.49 (0.0001)	0.62 (0.0001)	1.20 (6.69) [1.11]	0.75 (9.20) [-3.07]**	140
1943-52	0.77 (0.0001)	0.79 (0.0001)	1.06 (19.15) [1.08]	0.89 (20.83) [-2.57]**	256
1933-42	0.90 (0.0001)	0.90 (0.0001)	1.41 (35.43) [10.30]*	1.06 (35.67) [2.02]*	301
others	0.84 (0.0001)	0.86 (0.0001)	1.09 (17.38) [1.43]	0.87 (19.31) [-2.89]**	131
total	0.79 (0.0001)	0.83 (0.0001)	1.23 (36.84) [6.89]*	0.93 (42.37) [-3.19]**	828

grosse84= gross earnings 1984

loge84= logarithm of gross earnings 1984

in square brackets t-ratio for the hypothesis that the
regression coefficient (b) = 1

* = one can reject the null hypothesis that $b=1$ in favour of
the alternative $b > 1$, at 0.05 significance level.

** = one can reject the null hypothesis that $b=1$, at 0.05
level of significance, in favour of the alternative $b < 1$
since the computed $t < -1.64$

In the other cases one cannot reject the null that $b=1$

APPENDIX II

Tests on Tab.7.2.a

1. Tests of the Hypothesis

$$H_0 : \rho = 1 \quad H_{A_1} : \rho \neq 1$$

$$H_{A_2} : \rho < 1$$

$$z = \sqrt{n-3} \cdot 1.1513 \log_{10} [(1+r) (1-\rho_0) / (1-r)(1+\rho_0)]$$

$$1.1. \quad r = 0.83, \quad n = 283$$

$$z = \sqrt{280} \cdot 1.1513 \log_{10} [1.83/0.17 \cdot 2] = 14.08$$

$$1.2. \quad r = 0.92, \quad n = 283, \quad z = 20.79.$$

$$1.3. \quad r = 0.95, \quad n = 283, \quad z = 24.85$$

For all the cases listed above, one can reject the null hypothesis that $\rho = 1$ in favour of the alternative $\rho \neq 1$ at 95% confidence level since $z > 1.96$, but one cannot reject H_0 in favour of $\rho < 1$ since $z > -1.645$.

2. Test of the Hypothesis

$$H_0 : \rho = \rho_0 \quad H_A : \rho < \rho_0$$

$$z = \sqrt{n-3} \cdot 1.1513 \log_{10} [(1+r) (1-\rho_0) / (1-r)(1+\rho_0)]$$

$$2.1: \quad r = 0.83, \quad n = 283, \quad \rho_0 = 0.95, \quad z = -10.77$$

At a 0.05 level of significance by using a one tailed test of the normal distribution, we reject the null hypothesis in favour of the alternative $\rho < 0.95$, since $z = -10.77 < -1.64$.

Tests on Tab.7.2.b

1. Tests of the Hypothesis

$$H_0 : \rho = 0 \quad H_A : \rho \neq 0$$

$t = r \sqrt{n-2} / \sqrt{1-r^2}$ has a Student's distribution with $n - 2$ degrees of freedom.

1.1 $r = 0.60$, $n = 29$

At a 0.05 level we can reject the null hypothesis in favour of the alternative $\rho \neq 0$, since $t_c = 3.897$ is greater than the value of t at 27 degrees of freedom (2.052).

2. Tests of the Hypothesis

$$\begin{aligned} H_0 : \rho &= 1 & H_{A_1} : \rho &\neq 1 \\ & & H_{A_2} : \rho &< 1 \end{aligned}$$

$$z = \sqrt{n-3} \cdot 1.1513 \log_{10} [(1+r)(1-\rho_0)/(1-r)(1+\rho_0)]$$

2.1. $r = 0.60$, $n = 29$

$$z = +1.78$$

One cannot reject the null hypothesis at 0.05 level of significance since $z < 2.052$.

3. Test of the Hypothesis

$$H_0 : \rho = \rho_0 \quad H_A : \rho < \rho_0$$

$$z = z_1 - z_2 / \sigma_{z_1 - z_2}$$

$$z_1 = 1.1513 \log_{10} [(1+r)/(1-r)]$$

$$z_2 = 1.1513 \log_{10} [(1+\rho_0)/(1-\rho_0)]$$

$$\sigma_{z_1 - z_2} = \sqrt{(1/n_1 - 3) + (1/n_2 - 3)}$$

3.1: $r = 0.60$, $n_1 = 29$, $n_2 = 283$, $\rho_0 = 0.83$,

Under H_0 $z = -2.42$.

At a 0.05 level of significance by using a one tailed test of the normal distribution, we reject the null hypothesis in favour of the alternative $\rho < 0.83$, since $z = -2.42 < -1.703$.

Tests on Tab.7.5.a

1. Tests of the Hypothesis

$$H_0 : \rho = 1 \quad H_{A_1} : \rho \neq 1$$

$$H_{A_2} : \rho < 1$$

$$z = \sqrt{n-3} \cdot 1.1513 \log_{10} [(1+r) (1-\rho_0) / (1-r)(1+\rho_0)]$$

$$1.1. \quad r = 0.15, \quad n = 283$$

$$z = -3.26$$

One can reject the null in favour of $\rho < 1$ at 0.05 level of significance since $z < -1.645$

$$1.2. \quad r = 0.08, \quad n = 283, \quad z = -4.46$$

One can reject the null in favour of $\rho < 1$ at 0.05 level since $z < -1.645$

$$1.3. \quad r = 0.26, \quad n = 283, \quad z = -1.34$$

One cannot reject the null hypothesis at 0.05 level of significance.

Tests on Tab.7.5.a

1. Tests of the Hypothesis

$$H_0 : \rho = 1 \quad H_{A_1} : \rho \neq 1$$

$$H_{A_2} : \rho < 1$$

$$z = \sqrt{n-3} \cdot 1.1513 \log_{10} [(1+r) (1-\rho_0) / (1-r)(1+\rho_0)]$$

$$1.1. \quad r = 0.03, \quad n = 29$$

$$z = -1.92$$

One can reject the null hypothesis at 0.05 level of significance in favour of $\rho < 1$ since $z < -1.703$ (one tailed -test).

2. Test of the Hypothesis

$$H_0 : \rho = \rho_0 \quad H_A : \rho < \rho_0$$

$$z = z_1 - z_2 / \sigma_{z_1 - z_2}$$

$$z_1 = 1.1513 \log_{10} [(1+r)/(1-r)]$$

$$z_2 = 1.1513 \log_{10} [(1+\rho_0)/(1-\rho_0)]$$

$$\sigma_{z_1 - z_2} = \sqrt{(1/n_1 - 3) + (1/n_2 - 3)}$$

$$2.1: r = 0.03, n_1 = 29, n_2 = 283, \rho_0 = 0.15,$$

Under H_0 $z = 0.59$.

At a 0.05 level of significance by using a one tailed test of the normal distribution, one cannot reject the null hypothesis in favour of the alternative $\rho < 0.15$, since $z = 0.59 > -1.703$.

Tests on Tab.7.9.a

1. Tests of the Hypothesis

$$H_0 : \rho = 1 \quad H_{A_1} : \rho \neq 1$$

$$H_{A_2} : \rho < 1$$

$$z = \sqrt{n-3} \cdot 1.1513 \log_{10} [(1+r)(1-\rho_0)/(1-r)(1+\rho_0)]$$

$$1.1. r = 0.79, n = 828, z = 20.82$$

$$1.2. r = 0.80, n = 828, z = 21.60.$$

$$1.3. r = 0.83, n = 828, z = 24.18$$

For all the cases listed above, one can reject the null hypothesis that $\rho = 1$ in favour of the alternative $\rho \neq 1$ at 95% confidence

level since $z > 1.96$, but one cannot reject H_0 in favour of $\rho < 1$ since $z > -1.645$.

2. Test of the Hypothesis

$$H_0 : \rho = \rho_0 \quad H_A : \rho < \rho_0$$

$$z = \sqrt{n-3} \cdot 1.1513 \log_{10} [(1+r)(1-\rho_0)/(1-r)(1+\rho_0)]$$

$$r = 0.83, n = 283, \rho_0 = 0.83, z = -3.39$$

At a 0.05 level of significance by using a one tailed test of the normal distribution, we reject the null hypothesis in favour of the alternative $\rho < 0.83$, since $z = -3.93 < -1.64$.

Tests on Tab.7.9.b

1. Tests of the Hypothesis

$$H_0 : \rho = 1 \quad H_{A_1} : \rho \neq 1$$

$$H_{A_2} : \rho < 1$$

$$z = \sqrt{n-3} \cdot 1.1513 \log_{10} [(1+r)(1-\rho_0)/(1-r)(1+\rho_0)]$$

$$1.1. r = 0.63, n = 27, z = 1.93$$

One cannot reject the null hypothesis at 0.05 level of significance in favour of $\rho < 1$, since $z < 2.05$.

2. Test of the Hypothesis

$$H_0 : \rho = \rho_0 \quad H_A : \rho < \rho_0$$

$$z = z_1 - z_2 / \sigma_{z_1 - z_2}$$

$$z_1 = 1.1513 \log_{10} [(1+r)/(1-r)]$$

$$z_2 = 1.1513 \log_{10} [(1+\rho_0)/(1-\rho_0)]$$

$$\sigma_{z_1 - z_2} = \sqrt{(1/n_1 - 3) + (1/n_2 - 3)}$$

2.1: $r = 0.63$, $n_1 = 27$, $n_2 = 828$ $\rho_0 = 0.79$,

Under H_0 $z = -1.59$

At a 0.05 level of significance by using a two tailed test of the normal distribution, one cannot reject the null hypothesis in favour of the alternative $\rho \neq 0.79$, since $z = -1.59 > -1.64$.

Tests of hypotheses regarding Tables 7.2.a and 7.9.b

2. Test of the Hypothesis

$$H_0 : \rho = \rho_0 \quad H_A : \rho < \rho_0$$

$$z = z_1 - z_2 / \sigma_{z_1 - z_2}$$

$$z_1 = 1.1513 \log_{10} [(1+r)/(1-r)]$$

$$z_2 = 1.1513 \log_{10} [(1+\rho_0)/(1-\rho_0)]$$

$$\sigma_{z_1 - z_2} = \sqrt{(1/n_1 - 3) + (1/n_2 - 3)}$$

2.1: $r = 0.83$, $n_1 = 283$, $n_2 = 828$ $\rho_0 = 0.79$,

Under H_0 $z = 1.69$

2.2: $r = 0.92$, $n_1 = 283$, $n_2 = 828$ $\rho_0 = 0.80$,

Under H_0 $z = 7.01$

2.3: $r = 0.95$, $n_1 = 283$, $n_2 = 828$ $\rho_0 = 0.83$,

Under H_0 $z = 9.17$

For the cases 2.1, 2.2, 2.3 listed above, by using a one tailed test of the normal distribution, one can reject the null

hypothesis that the correlation coefficient of gross earnings of married women and of married men is equal, at a 0.05 level of significance, in favour of the alternative that the correlation coefficient of married women's gross earnings is greater than the correlation coefficient of married men's gross earnings, since the computed z is greater than 1.64 in all three cases.

Therefore one can claim that the gross earnings mobility for married women who are continuously working from 1984 to 1988 is lower than the gross earnings mobility of married men in the constant sample.

$$2.4: r = 0.60, n_1 = 29, n_2 = 27, \rho_0 = 0.63,$$

$$\text{Under } H_0 \quad z = -0.17$$

At 0.05 level of significance, one cannot reject the null hypothesis that $\rho = 0.63$, i.e. that for the discontinuous sample gross earnings mobility differs by gender.

$$2.5: \text{Test on } H_0 : \alpha = 0.04 \quad \text{against } H_a : \alpha \neq 0.04$$

where α = difference between correlation coefficient of gross earnings from 1988 to 1987, and correlation coefficient between gross earnings in 1988 and in 1984 for married women in the constant sample.

0.04 = estimated difference between correlation coefficient of gross earnings from 1988 to 1987, and correlation coefficient between gross earnings in 1988 and in 1984 for married men in the constant sample.

$$a = 0.95 - 0.83 = 0.12, n_1 = 283$$

$$b = 0.83 - 0.79 = 0.04, n_2 = 828$$

$$\text{Under } H_0 \quad z = 1.16$$

At 0.05 level of significance, one cannot reject the null hypothesis that $\alpha = 0.04$, since z is lower than 1.64. Therefore we cannot reject the hypothesis that the change occurred over time in the correlation coefficients of gross real earnings for the constant sample significantly differs for married women and married men.

CHAPTER 8 - ESTIMATION OF THE WAGE-EXPERIENCE DYNAMIC MODEL OF FEMALE LABOUR SUPPLY WITH U.K. DATA

INTRODUCTION

In this Chapter we show the results of the application of our model to UK data. For the estimation of our theoretical model, which we have described in Chapter 4, we use Family Expenditure Survey data (FES). A description of this data set and of the sample used for our empirical research can be found in Chapter 6.

We have followed a 5 step procedure to estimate the model with FES data:

- 1) Probit on the employment probability of married women in the sample in this stage we estimate a reduced form;
- 2) estimation of a log wage equation corrected for selection bias;
- 3) estimation of log of Consumption equation in order to substitute the marginal utility of net worth term in the log leisure equation;
- 4) 2 Stage least squares estimation of a log linear approximation for the structural form demand for leisure equation. In this stage we have also tested for the significance of the predicted against the actual measures of wages and consumption;
- 5) 2 Stage least squares estimation of the structural form model for the demand of leisure which allows us to recover estimates of the structural parameters of the model and estimate of the intertemporal substitution elasticity.

In Section 1 we present the results of the estimation carried out in steps 1 to 4, while Section 2 of this Chapter is devoted to the presentation of the results on the estimation of stage 5 and to a comparison of the estimates obtained with those of other models on female life cycle labour supply.

SECTION 8.1 - ESTIMATION OF LOG LEISURE AND WAGE EQUATIONS ON FES DATA

8.1.1 - Probit on probability of employment of married women in the sample

The Probit model used to construct the selection bias term in the wage equation is the following: (number of cases 1,791, t-ratio in brackets).

$$\begin{aligned}
 (1) \text{ Prob (WPARNS=1)} = \Phi [& 1.18 + 0.36 \text{AGE}/10 - 0.09 \text{ AGESQ}/100 - 1.73 \text{ DO1} \\
 & (1.79) \quad (1.28) \quad (-2.44) \quad (-11.02) \\
 & - 1.47 \text{ D23} - 0.75 \text{ D410} - 0.03 \text{ D1118} - 0.12 \text{ NKIDS} \\
 & (-9.13) \quad (-5.02) \quad (-0.21) \quad (-2.41) \\
 & - 0.89 \text{ HUNOCC} - 0.01 \text{ EDUC} - 0.17 \text{ EDUCH} \\
 & (-2.56) \quad (-0.47) \quad (-0.85) \\
 & - 0.02 \text{ HCLRK} + 0.03 \text{ HMANSK} + 0.03 \text{ HMUNSK} \\
 & (-0.12) \quad (0.32) \quad (0.33) \\
 & + 0.24 \text{ HSER} - 0.004 \text{ HIND}] \\
 & (2.18) \quad (-0.75)
 \end{aligned}$$

WPARNS = 1 if married woman is employed in year 1983, 0 otherwise.

AGE = age of married women; AGESQ = age squared;

DO1 = 1 if the youngest child is from 0 to 1 year old;

D23 = 1 if the youngest child is from 2 to 3 years old;

D410 = 1 if the youngest child is from 4 to 10 years old;

D1118 = 1 if the youngest child is from 11 to 18 years old;

NKIDS = number of children in the family;

EDUC = years of schooling of woman;

EDUCH = years of schooling of husband;

HUNOCC = 1 if husband is unemployed, 0 otherwise;

HCLRK = 1 if husband is clerk, 0 otherwise;

HMANSK = 1 if husband is in manual skilled position, 0 otherwise;
is teacher, professional or administrative;

HMUNSK = 1 if husband is in manual unskilled position, 0 otherwise;

HSER = 1 if husband is in Service sector, 0 otherwise;

HIND = 1 if husband is in Industry, 0 otherwise;

Φ = cumulative standard normal density function

TAB.1 - EFFECT OF THE INDEPENDENT VARIABLES ON
MARRIED WOMEN'S EMPLOYMENT PROBABILITY¹

AGE	- 0.01
D01	- 0.68
D23	- 0.58
D410	- 0.30
D1118	- 0.01
NKIDS	- 0.05
HUNOCC	- 0.35
EDUC	- 0.004
EDUCH	- 0.07
HCLRK	- 0.01
HMANSK	- 0.01
HMUNSK	0.01
HSER	0.09
HIND	- 0.02

The equation above is interesting in its own right, apart from having a key role in the five step estimation method described at the beginning of this Chapter. A first stimulating result is the size and significance of the number, presence and age of young children in the household (variables NKIDS, D01, D23 and D10 in equation 1 and Tab.1) on their mothers' employment probability. These coefficients dominate women's employment probability decision in equation 1: the discouraging effect on married women's employment being higher the less is the youngest child's age.² Moreover, differently from other studies on female labour supply in the U.K.³, even when we control for the age of the youngest

¹ This table contains the derivatives of the function estimated in equation 1 for each of the independent variables in the model, evaluated at the sample means.

² As one can notice from equation 1 the coefficient of D01 is -1.73 and the one of D23 is -1.47.

³ The Office Population Censuses and Survey (1984), and Martin and Roberts (1984c), both found that the variable number of children does not play an important role on female labour supply of British women once the age of the youngest child is taken into account.

child in the family, the variable "number of children" (NKIDS) is still having a discouraging and significant effect on married women's employment probability, each additional child decreasing the employment probability by 0.05. On the whole, the presence of a discouraging effect of young children on their mothers' employment probability is a result predicted both by economic theory and by previous analyses of female labour supply in the U.K.⁴ This is also predictable if one takes into account the system of maternal leave and of child care facilities existent in the U.K. which has been found to discourage women's continuous work profile over their lives.⁵

The probability of being employed of a 17 years old woman is 0.0004, against -0.002 for a 20 years old and -0.01 for a 40 years old woman.

According to Tab.1 one year of extra education decreases the employment probability of women by 0.4 percentage points, however, as equation 1 shows, the impact of women's education (EDUC) on their employment probability is not significant. On the other hand by analysing the results shown in the following section one can claim that there is a positive indirect effect of education on female labour supply through its positive impact on wages.⁶

In the employment probability equation we have introduced also a set of dummies referring to the husband's employment status.

⁴ Amongst others this result has been found by Joshi (1984 and 1986) and by Martin and Roberts (1984a), for the UK.

⁵ Maternity leave has been introduced as a statutory right only in 1977, and, as the research of Daniel (1981) shows 46% of working women were eligible for it. Moreover Dex and Puttick's (1988) analysis based on Women and Employment Survey Data (1980) shows how the use of maternity leave is constrained by the lack of affordable child-care facilities. This brings them to opt for part-time jobs when they return to paid employment after childbearing rather than staying in full-time employment and using maternity leave.

⁶ This result has also been found by Greenhalgh's (1980) analysis based on the General Household Survey Data of 1971.

only two of them turn out to have a significant effect: the presence of a husband employed in the Service Sector (HSER) and the presence of an unemployed husband (HUNOCC). The presence of a husband employed in the Service Sector increases his wife's employment probability by 0.09 while the presence of an unemployed husband lowers his wife's employment probability by 0.35. The presence of a negative and significant coefficient is predicted by the discouraged worker theory and against the added worker theory.⁷ However there are different explanations given by economic theory to a negative impact of an unemployed husband on his wife's labour employment probability, the effect may arise:

- 1) because of the higher probability of wives of unemployed of living in areas characterized by higher unemployment rates and with less opportunities of work for both men and women;
- 2) via a greater involvement of the husband in non-market activities. This increase has an ambiguous effect on his wife's labour supply if husband and wife's leisure are complements, but will increase her labour supply if husband and wife's leisure are substitutes.⁸ In our employment equation it seems that husband and

⁷ The prevalence of a discouraged worker effect is found both in time series and in cross section analyses on female labour supply in the U.K. Refer amongst others to the analyses of: Greenhalgh (1977), Berg and Dalton (1977), McNabb (1977), Grice (1978), Elias (1979), Layard, Barton and Zabalza (1980) and Joshi (1986). The analysis of Joshi and Owen (1987) finds evidence of insignificant discouraged worker effect in recent periods for 20-59 years old women, by means of Census and Labour Force Survey data. The analysis by Elias (1979) based on Family Expenditure Survey data shows that a 1% increase in the husbands' unemployment rates causes a decrease in female participation rates in FES households of 1.5%.

⁸ If husband and wife's leisure times are complements, the effect of husband's unemployment on the wife's employment probability is ambiguous. In fact if on one hand the increase in time spent by the husband in household activities (like housework or caring for children) will reduce the need for his wife's time spent in household's activities, on the other hand since his leisure activity is a complement with respect to his wife's leisure, her leisure time will increase too. For tests on these effects refer to Ashenfelter and Heckman (1974) and to Killingsworth (1983).

wife's leisure time are complements and that the net effect of an increase in husband's non market time on his wife's employment probability is negative.

3) via assortative mating which makes wives of men not likely to be employed to be less likely to be employed as well, as Lundberg (1985, p.14) stresses.

4) because of the system of Supplementary Benefit in the U.K..⁹ This system, according to Joshi (1986), is probably responsible for the existence at the micro level of a negative effect of unemployed men on their wives' labour supply contrary to the added worker hypothesis.¹⁰

8.1.2 - Estimation of a wage equation

The wage equation to be estimated according to the theoretical model has the following loglinear specification:¹¹

$$\log w_{i,t} = b_1 + b_2 K_{i,t-1} + b_3 EDUC_i + b_4 EDUC_i K_{i,t-1} + \epsilon_{2,i,t}$$

where:

$\log w_{i,t}$ = log of marginal net wage for woman i at time t;

$K_{i,t-1}$ = past work experience of woman i: probability of being employed at time t-1

$EDUC_i$ = years of schooling of woman i;

⁹ As Layard, Barton and Zabalza (1980, p.62) stress: "About half of the families of unemployed men receive Supplementary Benefit, which, after disregards, is reduced pound for pound for any earnings of the wife. This creates an incentive for wives to stop work when their husbands become unemployed, and cases have been observed where this happens".

¹⁰ Joshi (1986) finds that wives of men with National Insurance or Supplementary Benefit are 11% less likely to be economic active than wives of other non-working men.

¹¹ On the advantages of a loglinear specification for the wage equation refer to Nakamura and Nakamura (1985b, pp.245-246 and pp.272-274).

EDUC₁ K_{1,t-1} = interaction between schooling and past work experience.

In this equation we assume the depreciation rate of past work experience to be equal to one, this implies that only last period work experience enters the wage equation.

The wage equation that we have used to predict the log of net wage in our log of leisure equation is equation (2) below; we have also estimated log of gross wage equation (equation 3) to carry out comparisons with the gross wage equation estimated with the German Panel data.¹²

$$(2) \log w = -0.49 + 0.002 \text{ AGE}/10 + 0.03 \text{ EDUC} + 0.12 \text{ EXP} \\ (-2.65) \quad (1.24) \quad (2.83) \quad (2.59) \\ + 0.14 \text{ RATIO} \\ (3.00)$$

$$R^2 = 0.02$$

NUMBER OF CASES = 911

$$(3) \log wg = -0.26 + 0.002 \text{ AGE}/10 + 0.06 \text{ EDUC} + 0.11 \text{ EXP} \\ (-1.33) \quad (1.75) \quad (5.73) \quad (2.29) \\ - 0.15 \text{ RATIO} \\ (-3.06)$$

$$R^2 = 0.07$$

NUMBER OF CASES = 911 (t-ratio in brackets)

log w = log of net wage of married women in year 1983;

log wg = log of gross wage of married women in year 1983;

AGE = age of married women;¹³

EXP = cohort constructed measure of employment status in year 1982, this is a proxy for K_{1,t-1}

EDUC = years of schooling of wife.

RATIO = Heckman's selection bias term.

¹² Refer to Section 9.1 for a comparison with the estimation carried out on German data.

¹³ We have also estimated wage equations with age of woman squared (AGESQ) in order to check the non linear effect of age on women's wage, however the coefficient of AGESQ turned out to be insignificant.

logw=log of net hourly marginal wage rate of married women in year 1983.

The latter has been computed by multiplying married women's gross hourly wage times (1-wife's marginal tax rate). The marginal tax rate has been computed by considering the ranges of household's tax unit incomes.

Since we do not rely on panel data for the U.K. we have to proxy the individual past work experience with a cohort constructed measure: EXP. This variable has been constructed by computing the mean employment rates in 1982 for married women in different cohorts and according to the presence and age of the youngest child in the family.¹⁴

The cohort constructed measure for past work experience (EXP) has been introduced to account for the effect of human capital accumulation on current wages. A positive effect of this variable on current wage is expected also because of seniority reasons. In both equations (2) and (3) past work experience has the expected positive effect on current wage.¹⁵ The rate of return of past employment on married women's gross wage is around 11%¹⁶

We have also tried the interaction between education and past work experience but this variable turns out not to be significant so we cannot claim, on the basis of this result, that individuals with higher than average level of schooling enjoy higher returns from past work-experience in terms of wages. On the other hand education has a positive and significant effect on married women's current wages, the rate of return of schooling (variable EDUC) being 6% for current gross wages and 3% for net wages. This result is in line with the prediction of economic theory, and may arise

$\text{lowg} = \log$ of gross hourly wage rate of married women in 1983. The latter has been obtained by dividing women's weekly normal gross wage by their normal hours of work per week.

¹⁴ For a more detailed analysis on this cohort proxy refer to Section 6.2.2.

¹⁵ As it will be discussed in Section 9.1 the cohort constructed past work experience used to proxy individual past work experience has an estimated effect on current wages lower than the one of the individual past work experience.

¹⁶ Also Stewart and Greenhalgh (1984) in their analysis on National Training Survey data (which collect in 1975/76 longitudinal information on more than 50,000 individuals in the UK through recall questions) found that those women who experienced interruptions in their work-profiles were more likely to earn less on average than other women.

either because investment in education may increase productivity in the labour market or because higher education is taken as a signal of higher productivity by the employer.

Older women tend to have higher current wages but the coefficient is not significant. The coefficient of the selection bias term is positive and significant in the marginal net wage equation (equation 2), this implies that marginal net wages tend to be higher for those women who are also more likely to be employed but, as equation 3 shows, this is not the case for gross wages.

8.1.3 - Estimation of log of Consumption equation

Equation (4) is the logarithm of household's consumption equation used to predict the logarithm of consumption (logCP) in the logarithm of leisure equation, in order to substitute the term for marginal utility of net worth in the log leisure equation.

$$\begin{aligned}
 (4) \log C = & 3.73 + 0.04 \text{ AGE}/10 - 0.17 \text{ D01} \\
 & (26.12) \quad (3.80) \quad (-3.82) \\
 & - 0.05 \text{ D23} + 0.01 \text{ D410} + 0.12 \text{ D1118} + 0.06 \text{ NKIDS} \\
 & (-1.07) \quad (0.35) \quad (0.04) \quad (4.36) \\
 & 0.03 \text{ EDUC} + 0.17 \text{ EDUCH} \\
 & (4.09) \quad (2.94) \\
 & - 0.15 \text{ HCLRK} - 0.15 \text{ HMANSK} - 0.24 \text{ HMUNSK} \\
 & (-3.77) \quad (-5.70) \quad (-7.69) \\
 & + 0.06 \text{ HSER} - 0.002 \text{ HIND} \\
 & (1.86) \quad (-0.98)
 \end{aligned}$$

$$R^2 = 0.15$$

Number of cases = 1,791 (t-ratio in brackets)

logC = log of consumption of the family in year 1983, i.e.
expenditure in all items per household deflated by
inflation to first month of year 1983;

AGE = age of married women;

D01 = 1 if the youngest child is from 0 to 1 year old;

D23 = 1 if the youngest child is from 2 to 3 years old;

D410 = 1 if the youngest child is from 4 to 10 years old;

D1118 = 1 if the youngest child is from 11 to 18 years old;

NKIDS = number of children in the family;
 EDUC = years of schooling of woman;
 EDUCH = years of schooling of husband;
 HCLRK = 1 if husband is clerk, 0 if he is teacher,
 professional or administrative;
 HMANSK = 1 if husband is in manual skilled position, 0 if he
 is teacher, professional or administrative;
 HMUNSK = 1 if husband is in manual unskilled position, 0 if
 he is teacher, professional or administrative;
 HSER = 1 if husband is in Service sector, 0 if he works in a
 non-service sector;
 HIND = 1 if husband is in Industry, 0 if he works in a
 non-Industry sector.

Better educated couples and older women have higher household's consumption, whereas the dummies included to account for the effect of husband's job on household's consumption (HCLRK, HMANSK and HMUNSK) have a negative coefficient.

8.1.4 - Estimation of a log leisure demand equation

In this stage we will estimate the general log linear functional form for the demand of leisure presented in Chapter 4:

$$\begin{aligned}
 \log L_{i,t} = & c_0 + c_1 \log CP_{i,t} + c_2 \log WP_{i,t} + c_3 \log W_{i,t+1}^e + \\
 & c_4 \log(T-L_{i,t+1}^e) + c_5 DO1_{i,t} + \\
 & c_6 D23_{i,t} + c_7 D410_{i,t} + c_8 NKIDS_{i,t} + \\
 & + \varepsilon_{3,i,t}
 \end{aligned}$$

$L_{i,t}$ = (120-hours of work of woman) = leisure hours of woman i at time t;

$\log CP_{i,t}$ = log of current household of woman i's consumption predicted by using the variables and coefficients in equation 4 above;

$\log WP_{i,t}$ = log of current wage of woman i predicted by using the variables and coefficients estimates of equation 2 (without ratio);

$\log W_{i,t+1}^e$ = log of expected wage for woman i at time t+1;

$\log(T-L_{i,t+1}^e)$ = log of expected hours of work at time t+1 by woman i;

D01 = 1 if the youngest child is from 0 to 1 year old;
D23 = 1 if the youngest child is from 2 to 3 years old;
D410 = 1 if the youngest child is from 4 to 10 years old;
NKIDS = number of children in the family.

We have carried out tests for the significance of the predicted versus the actual measures for consumption and marginal net wages.¹⁷ The results of the tests performed lead us to use the predicted measures for both household's consumption (logCP) and woman's marginal net wage (logWP) in the estimated equations referred to below.

Equation (5) is the Two-Stage Least Squares (2SLS) estimation of a log linear approximation to our structural form model for the demand of leisure. Cohort constructed measures for forward work experience and forward wages substitute the individual variables of the theoretical model. The variable EXPF is a cohort proxy for individual forward work experience. It measures the gain in the probability of working next period if one decides to work (and therefore to earn) in the current period. Also logWF is a cohort constructed variable for forward wages.

In equation (5) we have used predicted marginal net wages (from equation 2) and predicted household's consumption (from equation 4) instead of the actual current variables. The Heckman's selection term (RATIO) has been constructed by using equation (1) on employment probability.

$$\begin{aligned}
 (5) \log L = & 4.20 - 0.004 \text{ NKIDS} + 0.12 \text{ D01} \\
 & (27.30) \quad (-0.61) \quad (2.08) \\
 & + 0.09 \text{ D23} + 0.09 \text{ D410} + 0.07 \log \text{CP} \\
 & (2.29) \quad (3.67) \quad (2.02) \\
 & - 0.24 \log \text{WP} + 0.09 \text{ EXPF} \\
 & (-2.48) \quad (1.00) \\
 & + 0.01 \log \text{WF} + 0.11 \text{ RATIO} \\
 & (0.40) \quad (3.25)
 \end{aligned}$$

¹⁷ For a detailed analysis of these tests refer to Appendix I to this Chapter.

$$R^2 = 0.30$$

Number of cases = 911 (married women working in year 1983)
(t-ratio in brackets)

logL = log leisure of married women;

L = (120 - normal hours of work of woman in week before 1983 interview);

logCP = equation 4;

D01 = 1 if the youngest child is from 0 to 1 year old;

D23 = 1 if the youngest child is from 2 to 3 years old;

D410 = 1 if the youngest child is from 4 to 10 years old;

NKIDS = number of children in the family;

logWP = log of predicted wage constructed by means of equation 2, without the ratio;

EXPF = cohort constructed forward work experience;

logWF = log of cohort and education constructed forward wage;

RATIO = Heckman's selection term.

The effect of the presence of young children in the family is lower on their mothers' hours of work than on their mothers' employment probability (equation 1 and Tab.1), but still from equation 5 one can see how highly significant is the impact of the youngest child in the family on her mother's distribution of time: the presence of a youngest child aged less than 2 increases women's time devoted to non market work activities by 12%, the presence of a youngest child aged from 2 to 3 or from 4 to 10 increases women's time devoted to non market work activities by 9 percentage points. When we account for the age of the youngest child in the family the impact of the number of children in the family (variable NKIDS) on their mothers' hours of work becomes insignificant as found by other analyses on married women's labour supply in the U.K.,¹⁸ while this was not the case in our employment probability equation (equation 1).

To recap: a high number of children in the family does reduce the employment probability of their mothers, but does not significantly affect their distribution of time between market and

¹⁸ Like Office Population Censuses and Surveys (1984) and Martin and Roberts (1984c).

non-market activities. On the other hand the presence of young children in the family significantly affects both the employment probability and the number of hours worked by their mothers. This is in line with one stylized fact of British married women's work behaviour referred to in Chapter 5: they tend to exit the labour market during childbearing and to work part-time afterwards, rather than staying in full-time employment, this can be closely related to the insufficient availability of affordable child care facilities for British families.

The predicted household's consumption has a positive effect on the demand for leisure, if we consider the household's consumption as a proxy of household's income this is in line with theoretical expectations.

The sign of the Heckman's selection term is not the one expected.

The coefficients of forward wage and forward work experience are insignificant. However one must stress that the latter are only cohort proxies for individual variables.

We have found the expected effect of predicted current marginal wage (logWP) on current decision about the distribution of time: a 1% increase in the marginal predicted net wage, according to equation 5, reduces married women's non-market time in 1983 by 0.24% .

SECTION 8.2 - STRUCTURAL FORM ESTIMATION

In this section we report the results of the estimation of the structural form equation presented in our theoretical model and referred to below:¹

$$\log L_{i,t} = d_0 + d_1 \log CP_{i,t} + d_2 \log WH_{i,t}$$

$L_{i,t}$ = (120-hours of work of woman) = leisure hours of woman i at time t ;

$\log CP_{i,t}$ = log of current household of woman i 's consumption predicted by using the variables and coefficients in equation 4 in Section 3;

$$\log WH_{i,t} = \log [WP_{i,t} + (b_2 + b_4 EDUC_i) * W_{i,t+1}^e * (T-L_{i,t+1}^e)]$$

$W_{i,t+1}^e$ = Expected wage for woman i at time $t+1$;

$T-L_{i,t+1}^e$ = Expected hours of work at time $t+1$ by woman i ;

b_2 = coefficient of past work experience in equation 2;

b_4 = coefficient of interaction of past work experience and education of woman in the wage equation;

$EDUC_i$ = years of schooling of woman;

This structural form is different from the one estimated in the previous section since the latter is just a loglinear approximation of the former. The two structural forms differ in the wage term. In the equation estimated here the wage term includes also the expected gain in forward wages whereas in the loglinear equation estimated in the previous section the expected gain in forward wages as well as the effect on forward work experience are added linearly to the term on predicted current wages.

The utility function of our model is:

$$U_{i,t} = A_{i,t} * [(L_{i,t}^\alpha - 1)/\alpha] + B_{i,t} * [(C_{i,t}^\mu - 1)/\mu]$$

where:

¹ Refer to Chapter 4 for a detailed analysis of our theoretical model.

$U_{i,t}$ = utility function of woman i at time t ;

$A_{i,t}$ = observed and unobserved factors affecting leisure for woman i at time t ;

$L_{i,t}$ = (120-hours of work of woman) = leisure hours of woman i at time t ;

$B_{i,t}$ = observed factors affecting consumption;

$C_{i,t}$ = consumption.

The coefficients of interest in the structural form equation are:

$$d_1 = (\mu-1)/(\alpha-1)$$

and

$d_2 = 1/(\alpha-1)$ = intertemporal substitution elasticity. Strict concavity of the Utility function requires that $\alpha < 1$.

In estimating the model above we have used a Two-Stage Least Squares (2SLS) estimation and we have used predicted household's consumption (from equation 4 in Section 8.1.3) instead of the actual current household's consumption. In order to construct $\log WH$ we have used the exponential transformation for equation (2) in section 8.1.2.

Equation 6.a is the 2SLS demand for leisure equation (t-ratio are in brackets, Standard Errors in square brackets)

$$\begin{aligned} (6.a) \log L_{i,t} = & 4.33 - 0.0002 NKIDS_{i,t} + 0.06 DO1_{i,t} \\ & (31.74) \quad (-0.03) \quad (1.65) \\ & [0.14] \quad [0.01] \quad [0.04] \\ & + 0.06 D23_{i,t} + 0.06 D410_{i,t} + 0.06 \log CP_{i,t} \\ & (1.88) \quad (4.05) \quad (1.64) \\ & [0.03] \quad [0.01] \quad [0.04] \\ & - 0.16 \log WH_{i,t} + 0.11 R_{i,t-1}^2 \\ & (-1.67) \quad (3.22) \\ & [0.10] \quad [0.03] \end{aligned}$$

$$R^2 = 0.30$$

Number of cases = 911 (women working in year 1983)

logL = log leisure of married women: (120 - normal hours of work in week before 1983 interview);

logCP = equation 4;

D01 = 1 if the youngest child is from 0 to 1 year old;

D23 = 1 if the youngest child is from 2 to 3 years old;

D410 = 1 if the youngest child is from 4 to 10 years old;

NKIDS = number of children in the family;

$WH_{i,t} = WP_{i,t} + \beta_2 W^e EXP^e$ (where W has been

predicted by taking the exponential of equation 2 in section 8.1.2 without ratio, and β_2 is from the

coefficient of past work experience in the estimated wage equation, we did not include the coefficient of the interaction term since it turned out to be insignificant).

RATIO= Heckman's selection term.

As we have already found in the log linear approximation to the structural form demand of leisure equation (equation 5), when we take into account the age of the youngest child in the family (D01, D23 and D410) the variable number of children in the family (NKIDS) is no longer significant in equation 6.a. However, the discouraging effect on married women's labour supply of the presence of young children in the family is lower in equation (6.a) than in the probit for the employment probability equation (equation 1)² and in the loglinear approximation to the structural form (equation 5). The discouraging effect on women's labour supply is significant only when the youngest child in the family is aged from 4 to 10 (the non-market time of married women increases by 6% when the youngest child in the family is aged from 4 to 10), while the presence of children aged less than 4

² Also Layard, Barton and Zabalza (1980) in their analysis on 3,877 married women aged 60 or under from General Household Survey data show that the presence of children under 3 in the family sensibly reduces the participation probability of white married women and that hours of work do not increase sensibly with child's age. A lower deterrent effect of the presence of children under 4 years old in the structural form than in the reduced form model for female labour supply has been found by Gomulka and Stern (1986) in their analysis on Family Expenditure Survey data from 1970/1 to 1982/83.

does not significantly affect their mothers' distribution of time between non-market and market activities. This result can again be interpreted by considering British married women's labour market behaviour. They do stop working during childbearing and when the child is young, when there are not enough affordable day care facilities for their youngest children (and this is shown by the negative and significant coefficients in the employment probability equation for D01 and D23), while they go back to work when their youngest children are older than 4 but they work in part-time jobs in order to match their reduced and more flexible working hours with the time-table of schools for their children.

Turning to the other variables in equation 6.a we can notice that the estimated coefficients of the log of predicted household's consumption (logCP) and of logWH allow us to recover three interesting structural parameters of the model. As we have referred to above, the estimate of the logWH coefficient, given the structure of our theoretical model, is an estimate of the intertemporal substitution elasticity, which, according to equation 6.a, is -0.16. Moreover by solving the following system of equations:

$$d_1 = (\mu - 1) / (\alpha - 1)$$

$$d_2 = 1 / (\alpha - 1)$$

(where d_1 is the coefficient of logCP, and d_2 is the coefficient of logWH) we have obtained the following estimates for α and μ :

$$\alpha = - 5.25$$

$$\mu = 0.625.$$

The estimate obtained for the substitution parameter (α) is consistent with the strict concavity of our utility function, since it is less than 1 as required. The estimate obtained for the intertemporal substitution elasticity suggests that for a 1% increase in the relative price of leisure between two years, given by WH (which includes also forward terms in wages and employment)

there will be around 0.16% (though not significant at 95% level) decrease in the leisure consumed by each married woman in the sample in those years.

$$\begin{aligned}
 (6.b) \log L_{i,t} = & 4.25 + 0.02 NKIDS_{i,t} - 0.03 D01_{i,t} \\
 & (20.93) \quad (3.59) \quad (-0.72) \\
 & [0.20] \quad [0.01] \quad [0.04] \\
 & - 0.01 D23_{i,t} + 0.03 D410_{i,t} + 0.05 \log CP_{i,t} \\
 & (-0.22) \quad (1.53) \quad (1.04) \\
 & [0.03] \quad [0.02] \quad [0.05] \\
 & - 0.27 \log WP_{i,t} + 0.14 RATIO_{i,t} \\
 & (-2.04) \quad (4.29) \\
 & [0.13] \quad [0.03]
 \end{aligned}$$

$$R^2 = 0.26$$

Number of cases = 911 (women working in year 1983)

$\log L$ = log leisure of married women: (120 - normal hours of work in week before 1983 interview);

$\log CP$ = equation 4;

$D01$ = 1 if the youngest child is from 0 to 1 year old;

$D23$ = 1 if the youngest child is from 2 to 3 years old;

$D410$ = 1 if the youngest child is from 4 to 10 years old;

$NKIDS$ = number of children in the family;

Where $\log WP$ has been predicted by using the following equation:

$$\begin{aligned}
 \log WP_{i,t} = & -0.40 + 0.001 AGEW_{i,t} + 0.03 EDUC_i + 0.07 RATIO_{i,t} \\
 & (-2.20) \quad (0.46) \quad (3.11) \quad (1.90)
 \end{aligned}$$

$AGEW$ = age of married women;

$EDUC$ = level of education of married women;

$RATIO$ = Heckman's selection term

We have also estimated a log leisure model where we do not include past work experience in the estimated wage equation (equation 6.b) in order to understand what changes when one does not take into account in the log leisure equation the effect of past work experience on current wages.

As one can see by comparing equation 6.b and equation 6.a, the estimate obtained for the intertemporal substitution elasticity is higher and more significant than the one that we

obtain in equation 6.a.³

Since the utility function used in our model is similar to the one used by Heckman and MaCurdy (1982) in their female labour supply model estimated on a sample of 672 married white women aged 30-65 in 1968 drawn from the Michigan Panel Study of Income Dynamics, it is interesting to compare our 2SLS estimates with their MLE estimates for the key structural parameters of the intertemporal substitution elasticity ($1/\alpha-1$) and of the substitution parameter (α). The estimate that we obtain for the intertemporal substitution elasticity is lower than the one obtained by Heckman and MaCurdy (1982) and it is not significantly different from the estimates for the intertemporal substitution elasticity of leisure demand obtained by Jakubson (1988, Tab.9, p.326, its value is -0.199) from his random effect model,⁴ and from the one obtained by Lilja (1986).⁵ However, we should stress that our model differs from the one of Heckman and MaCurdy (1982) not only for the assumption on intertemporal separability of the budget constraint but also for other important features: different data set, different set of explanatory variables employed, and different estimation method used. Therefore, consistently with the analyses conducted by Mroz (1987), Theeuwes and Woittiez (1990), we cannot state that the lower estimate obtained for the intertemporal elasticity of substitution from our model is

³ However, one cannot reject the null hypothesis that the coefficient of logWH is significantly different from 0.27 as one can see in the Appendix II to this Chapter. Moreover the t-ratio for the coefficient of logWP in equation 6.b is higher than the one of logWH in equation 6.a, but it is only -2.04.

⁴ Jakubson's (1988) analysis is based on a sample of 924 white married women aged from 20 to 50 years in 1968 drawn from the Panel Study of Income Dynamics.

⁵ Lilja's (1986) estimation is again based on Panel Study of Income Dynamics data and contains estimates of intertemporal substitution elasticity both for males and females under certainty or uncertainty. The intertemporal substitution elasticity for females under certainty goes from -0.14 to -0.15 and it is therefore very close to our 2SLS estimate.

certainly due to the different assumption made on the relevance of past work experience in the wage equation. Similarly we should be cautious in comparing our estimate on intertemporal elasticity of substitution with the ones obtained by the other models referred to above, since they differ from our model in many respects.

	Heckman and MaCurdy (1982)	Our 2SLS model (6.a)	Model without past work experience (6.b)
$1/(\alpha-1)$	-0.406	-0.16	-0.27
α	-1.44	-5.25	-2.70

The sensitivity analysis conducted by comparing the estimates obtained by two different models (equations 6.a and 6.b) on the same data set allows us to state that by considering past work experience in the wage equation (as we have done in model 6.a) one gets a lower and less significant estimate for the intertemporal elasticity of substitution for labour supply and a less transitory labour supply over the life cycle with respect to the estimate obtained when one neglects the past work experience effect on current wages (though as shown in Appendix II, we cannot reject the null hypothesis of no difference between the two estimates obtained).

APPENDIX I

TEST ON THE SIGNIFICANCE OF PREDICTED WAGES AND CONSUMPTION

As we have mentioned in Section 8.1.4 of this Chapter, we need to test the significance of the predicted measures for consumption of the household and for the wife's marginal wage on the log leisure equations that we have estimated in Section 8.1.4 and in Section 8.2. A significant coefficient for the residual (= actual - predicted value of a certain variable) would lead us to introduce the predicted, instead of the actual measure in the estimated equation.

Let's start with the test performed for predicted consumption. We have estimated the following log of leisure equation on a sample of 911 women in our sample.

$$\begin{aligned}
 \text{(a) } \log L &= 4.22 - 0.003 \text{ NKIDS} + 0.12 \text{ D01} \\
 &\quad (27.95) \quad (-0.57) \quad (2.08) \\
 &+ 0.09 \text{ D23} + 0.09 \text{ D410} + 0.07 \log C - 0.13 \text{ RESC} \\
 &\quad (2.32) \quad (3.69) \quad (2.00) \quad (-3.47) \\
 &- 0.25 \log WP + 0.08 \text{ EXPF} \\
 &\quad (-2.64) \quad (0.90) \\
 &+ 0.01 \log WF + 0.11 \text{ RATIO} \\
 &\quad (0.44) \quad (3.12)
 \end{aligned}$$

$$R^2 = 0.33$$

Number of cases = 911

$\log L$ = log leisure of married women in 1983;

$\log C$ = log of consumption of the family in year 1983, i.e. expenditure in all items of the household deflated by first month of year 1983;

$\log CP$ = log of current household of woman i's consumption predicted by using the variables and coefficients in equation 4 in section 8.1.3;

$\text{RESC} = \log C - \log CP$;

$\text{D01} = 1$ if the youngest child is from 0 to 1 year old;

$\text{D23} = 1$ if the youngest child is from 2 to 3 years old;

$\text{D410} = 1$ if the youngest child is from 4 to 10 years old;

NKIDS = number of children in the family;

$\log WP$ = log of predicted wage constructed by means of equation 2, (Section 8.1.2 of this Chapter), without the ratio;

EXPF = cohort constructed forward work experience proxy for the individual measure of expected forward work experience. We have assumed rational expectations and that the forecast errors go into the error term;

$\log WF$ = log of cohort and education constructed forward wage proxy for the individual measure of expected forward wage. We have assumed rational expectations and that the forecast errors go into the error term;

RATIO = Heckman's selection term.

Since in equation (a) the residual (RESC) turned out to be significant we did include logCP in the log leisure equations estimated. In equation (b) below we have tested for the significance of the predicted against the actual marginal wage in the log of leisure equation, again, since the residual RESW have been found to have a significant effect we have included log of predicted wage (logWP) instead of the current actual wage in the log leisure equations referred to in section 8.1.4 and in section 8.2.

$$\begin{aligned}
 \text{(b) logL} &= 4.12 + 0.01 \text{ NKIDS} + 0.05 \text{ D01} \\
 &\quad (19.85) \quad (1.23) \quad (0.63) \\
 &\quad + 0.03 \text{ D23} + 0.05 \text{ D410} + 0.07 \text{ logCP} + 0.45 \text{ RESW} \\
 &\quad (0.57) \quad (1.46) \quad (1.49) \quad (3.26) \\
 &\quad - 0.36 \text{ logMARGW} + 0.13 \text{ EXPF} \\
 &\quad (-2.61) \quad (1.20) \\
 &\quad + 0.02 \text{ logWF} + 0.11 \text{ Ratio} \\
 &\quad (0.56) \quad (2.05)
 \end{aligned}$$

$$R^2 = 0.27$$

Number of cases = 911 (with current net marginal wage greater than 0).

logL = log leisure of married women in 1983;

logCP = log of current household of woman i's consumption predicted by using the variables and coefficients in equation 4 in section 8.1.3;

logMARGW = log of actual marginal net wage of woman;

logWP = log of predicted wage constructed by means of equation 2 (Section 8.1.2), without the ratio;

RESW = logMARGW - logWP;

D01 = 1 if the youngest child is from 0 to 1 year old;

D23 = 1 if the youngest child is from 2 to 3 years old;

D410 = 1 if the youngest child is from 4 to 10 years old;

NKIDS = number of children in the family;

EXPF = cohort constructed forward work experience proxy for the individual measure of expected forward work experience. We have assumed rational expectations and that the forecast errors go into the error term;

logWF = log of cohort and education constructed forward wage proxy for the individual measure of expected forward wage. We have assumed rational expectations and that the forecast errors go into the error term;

RATIO = Heckman's selection term.

APPENDIX II

In this Appendix we test for the significance of the difference between the coefficient β_1 of logWH in equation (6.a) and the coefficient β_2 of logWP in equation (6.b).

The value of the coefficient of logWH in equation 6.a (where logWH takes into account the effect of past work experience on current wages and, consistently with our theoretical model, contains also terms in forward employment status and wages) is -0.16 and the S.E. is 0.10. The value of the coefficient of logWP in equation (6.b) (where we neglect the effect of past work experience on current wages and we do not consider forward terms in employment status and wages) is -0.27 and its S.E. is 0.13.

We assume that the covariance of the two coefficients is null.

$$H_0 : \beta_1 = \beta_2 \Rightarrow \beta_1 - \beta_2 = 0$$

$$t_c = \frac{\beta_1 - \beta_2}{\sqrt{\text{var}(\beta_1) + \text{var}(\beta_2) - 2 \text{Cov}(\beta_1, \beta_2)}} =$$

$$t_c = \frac{-0.16 + 0.27}{(0.10^2 + 0.13^2)^{1/2}} = \frac{0.11}{0.16} = 0.69$$

We cannot reject at 5% level of significance the hypothesis that $\beta_1 = \beta_2$, since $t_c < 1.64$.

CHAPTER 9

ESTIMATION OF THE WAGE-EXPERIENCE DYNAMIC MODEL OF FEMALE LABOUR SUPPLY ON WEST GERMAN DATA

Introduction

In this Chapter we present the results of the estimation of a quasi reduced form model for labour supply of West German married women by using panel data. We have chosen to include Germany in this analysis because of its peculiar trends in female labour supply summarized in Section 5.1 and also to test the effect of different institutional factors at work in the U.K. and in West Germany on female labour supply. One should also stress that there are only a few studies on West German women's labour supply available and that our analysis adds new information on this topic.

In Chapter 6 we have described the information and structure of the Socio economic Panel and of the sample that we use for our application in this Chapter.

The key feature of the theoretical model presented in Ch.4 is that past work experience affects the current level of wages, and we include this variable in the estimation of our wage equation on West German data carried out in Section 9.1.

The expected positive and significant effect of past work experience on the current level of wages bears important implications also on current labour supply choices of women. In fact their decision on current participation must take into account also the effect that current participation has on forward

earnings. Therefore our probability of employment equation estimated in Section 9.2, together with demographics, other income of the family, and current predicted wage, will also contain the expected gain in forward wages.

The presence of a positive and significant effect of past work experience on the current level of wages implies that the effect of current employment decision on forward wages (and therefore on forward participation) enters the payoff of current employment, as the payoff functions (9.1.a and 9.1.b) below show. In these functions we consider only the effect of past work experience on $t+1$ wages and not the effect of other forward terms in wages ($t+2, \dots, t+n$) and we assume no rationing.

$$9.1.a. U_{i,t}^1 = f_1\{w_{i,t}, E_t(w_{i,t+1} | \text{Par}_{i,t} = 1), Z_{i,t}, OY_{i,t}\} \text{ if woman } i \text{ works}$$

$$9.1.b. U_{i,t}^0 = f_0\{E_t(w_{i,t+1} | \text{Par}_{i,t} = 0), Z_{i,t}, OY_{i,t}\} \text{ if woman } i \text{ does not work in period } t$$

$$9.1.c. \text{Probability } (\text{Par}_{i,t} = 1) = \text{Prob}(U^1 - U^0 > 0)$$

where:

$\text{PAR}_{i,t} = 1$ when woman works for a positive wage in week before 1987 interview;

$w_{i,t}$ = wage at time t for woman i ;

Z = demographics affecting leisure and consumption. These demographics are also a proxy for fixed costs of working connected to child-care.

OY = other household's income.

This payoff function differs from other models since it embeds also the effect of current employment on expected forward wages. In Section 9.2 we estimate the employment probability shown above and we compare the results obtained by estimating our wage-experience model to the ones of models which neglect the

effect of past work experience on current wages.

A Bivariate Probit for the employment probability and the probability of being employed full-time in the week before 1987 interview is presented in Section 9.3. In Section 9.4 we summarize the results obtained by the estimation of our wage-experience model of female labour supply on West German data and we compare them with the results obtained by estimating our model on U.K. data.

9.1 - Estimation of a Wage Equation

The crucial feature of the model of female labour supply that we have presented in Chapter 4 is that we relax the intertemporal separability assumption of the lifetime budget constraint. This is achieved by assuming that the current level of wages is affected by past work experience. Moreover the wage and earnings mobility analysis by gender carried out in Chapter 7 shows how married women's probability of experiencing an increase in their gross earnings is significantly lower when they have a broken work-profile, and that upward earnings mobility is generally higher for married men than for married women, the former being more likely to have a continuous work-profile over their life-cycle than the latter. Therefore consistently with our wage-experience model on labour supply and with the results of wages and earnings mobility analysis performed, we expect to find a positive effect of past work experience (EXP) on the wage equation estimated on a sample of 511 West German women who were working in week before 1987 interview.

As shown in Chapter 6, gross hourly wages tend to increase with the level of education of German married women and the gain in terms of education is higher for their husbands included in the sample.¹ By introducing the variable EDUCATION in the right hand side of the estimated wage equation we will investigate whether the difference shown by descriptive statistics provided in Ch.6 arises also in the regression analysis. We will also test whether the payoff of past-work experience on current wages significantly differs across women characterized by different levels of education, by introducing an interaction term (EDEX) amongst the right hand side variables in the wage equation.

¹ Refer to Tab.6.15 in Chapter 6.

The wage equation below has been corrected for selection bias by using equation (1) in Appendix I to construct Heckman's λ . The dependent variable is the logarithm of gross hourly real wages (deflated by using consumer price indices and 1984 as base year).

$$(4) \log w_{1i} = 0.76 + 0.05 \text{ AGE}_{1i} - 0.0006 \text{ AGESQ}_{1i} + 0.06 \text{ EDUC}_{1i} \\ (1.16) \quad (1.61) \quad \quad \quad (-1.58) \quad \quad \quad (7.16) \\ + 0.008 \text{ EDEX}_{1i} + 0.24 \text{ EXP}_{1i} + 0.08 \lambda_{1i} \\ (2.03) \quad \quad \quad (4.39) \quad \quad \quad (0.41)$$

$R^2 = 0.16$ $n.\text{obs.} = 511$

(t-values are in brackets)

$\log w_{1i}$ = log of gross hourly wage in 1987 deflated by using price indices base year 1984;

AGE= age of married women;

AGESQ= age of married women squared;

EDUC = years of schooling of women;

PAR86F = 1 if woman was working full-time in week before 1986 interview.

EDEX = (EDUC*PAR86F);

EXP = 1 if woman was working in week before 1986 interview with positive gross wage;

λ = Heckman's λ , constructed by using Probit (1) in Appendix I.

The coefficients estimated in equation (4) are in line with the assumptions of the theoretical model presented in Ch.4.² An additional year of schooling increases current gross wage of West German married women by 6% (as we have found also in the estimation of this model with UK data³) and has also a positive indirect effect on the current level of wages since it enhances the human capital accumulation of past work experience in full

² The coefficient of the Heckman's λ is positive as expected, but it is not significant (as found amongst others also by Merz, 1990, p.257, in his estimation based on the first wave of the Panel).

³ Equation 3 in section 8.1.2. For a test on the difference between the coefficients of EDUC in the two equations refer to Appendix VI. This estimate is also close to the one found by Strom and Wagenhals (1988, p.21).

time jobs (EDEX) by one per cent.⁴ On the other hand being employed in week before 1986 interview increases current gross wages of West German married women by 24 percentage points, a much higher effect than the one that we have predicted by using cohort proxies with UK data (for a test on the difference between the coefficients of past work experience in the two equations refer to Appendix VI). We have estimated also wage equations with different variables expressing past work experience like WORK86 (a cohort constructed variable similar to the one used to proxy past work experience in the application of our model to UK data shown in Chapter 8) and WOR86 (=1 if woman has been working sometimes during year 1986) but they turned out not to be significant. Equation 4.2 below shows the effect of the cohort proxy for past work experience on current gross hourly wages.

$$\begin{aligned}
 (4.2) \quad \log w_{g87} = & 1.10 + 0.04 \text{ AGE} - 0.0005 \text{ AGESQ} + 0.06 \text{ EDUC} \\
 & (1.52) \quad (1.21) \quad \quad (-1.18) \quad \quad (6.93) \\
 & + 0.19 \text{ WORK86} - 0.002 \lambda \\
 & \quad \quad (1.32) \quad \quad (-0.01) \\
 R^2 = & 0.11 \quad \quad \quad n.\text{obs.} = 511 \\
 & (t\text{-values are in brackets})
 \end{aligned}$$

The not significant effect of WORK86 is probably to be imputed to the lower precision of the cohort-constructed proxy for past work-experience with respect to the individual variable available which refers to the employment status in the week preceding the interview.⁵

The positive effect of past work experience on current wages has also important effects on the employment probability of West German married women (as we will show in the following Section). A

⁴ We are not aware of any other study which has estimated this effect on West German data.

⁵ For a detailed description of the different variables on past work experience employed in our analysis refer to Chapter 6.

positive and significant effect of past work experience on current wages of German married women has also been found by Merz (1987,1990) though his measure of past work experience differs from ours since he used the retrospective information contained in the first wave of the German Panel.⁶

Equation (4) will be used in the following section to predict current wages, and forward wages. In Appendix II to this Chapter we report the results of the other wage equations that we have estimated.

⁶ In other country studies a positive effect of past work experience on the current level of wages has been found, amongst others, by Eckstein and Wolpin (1989) and by Weiss and Gronau (1981).

9.2 - Estimation of Employment Probability Model for West German married women

The positive and significant effect of past work experience on the current level of wages bears important implications also on current labour supply choices of women. As shown in the Introduction to this Chapter, their decision on current participation must take into account also the effect that current participation has on forward earnings. Therefore our Probit models for the probability of employment estimated below, together with demographics, other income of the family, and current predicted wages, contain also the expected gains in forward wages.

$$\begin{aligned}
 (9.1.1) \text{ Prob} (PAR_{i,t}=1) = & \Phi [a_0 + a_1 OY_{i,t} + \\
 & a_2 NKID_{i,t} + a_3 D01_{i,t} + a_4 D23_{i,t} + a_5 D45_{i,t} + a_6 D610_{i,t} \\
 & + a_7 D1115_{i,t} \\
 & + a_8 \log (wp_{i,t} + E_t wg_{i,t+1})] + a_9 \varepsilon_{i,t}
 \end{aligned}$$

Φ = cumulative standard normal density function

Where OY is other income of the household, NKID is the number of children in the household aged less than 15 in 1987, D01, D23, D45, D610 and D1115 are dummies for the age of the youngest child in the family (age: 0-1, 2-3, 4-5, 6-10, 11-15); $wp_{i,t}$ is the current gross wage predicted by using equation (4) in Section 9.1, wg measures the expected gain in forward wages, i.e.:
 wg = expected gain in forward wages:

$$\begin{aligned}
 &= \exp (\log wp_{i,t+1}^e | PARF_{i,t} = 1) - \exp (\log wp_{i,t+1}^e | PARF_{i,t} = 0) = \\
 &= \exp (1 + 0.05 AGE_{i,t+1} - 0.0006 AGESQ_{i,t+1} + 0.068 EDUC_i) - \\
 &\quad \exp (0.76 + 0.05 AGE_{i,t+1} - 0.0006 AGESQ_{i,t+1} + 0.06 EDUC_i)
 \end{aligned}$$

We have used the wage equation (4) in order to predict forward

wages.

$PARF_{1,t}$ is equal to 1 when the woman works full-time in week before 1987 interview.

Equation 9.1.1 is the model closest to our theoretical specification for the payoff of working function described in the Introduction to this Chapter. We have estimated also two other Probit models which differ from 9.1.1 because of the wage term. Equation 9.1.2 neglects the gain in the expected forward wages of current employment (wg) included in equation 9.1.1 and embeds only the effect of past work-experience on predicted wages. Equation 9.1.2 has been estimated to detect how the estimation of the current employment probability can change when one takes into account the effect of past work experience on current wages (wp) but does not consider its effects on forward wages. However by comparing the two wage terms employed in equations 9.1.1 and 9.1.2, one must notice that the two differ only in the expected gain in forward wages (wg) which shows little variation (refer to the expression for the term wg given above).

Equation 9.1.3 is just a static labour supply model without any term in past work experience entering the wage equation, where:

$$wd = 1.42 + 0.03*AGE - 0.0004*AGESQ + 0.06*EDUC$$

(wage equation without past work experience)

We expect $a_g > b_g > c_g$ though the little variation in wg (expected gain in forward wages) makes us uncertain about the results of the first hypothesis test ($a_g > b_g$).

$$(9.1.2) \text{ Prob } (PAR_{i,t}=1) = \Phi [b_0 + b_1 OY_{i,t} +$$

$$b_2 NKID_{i,t} + b_3 DO1_{i,t} + b_4 D23_{i,t} + b_5 D45_{i,t} + b_6 D610_{i,t} \\ + b_7 D1115_{i,t} + b_8 \log wp_{i,t}] + b_9 \varepsilon_{i,t}$$

$$(9.1.3) \text{ Prob } (PAR_{i,t}=1) = \Phi [c_0 + c_1 OY_{i,t} +$$

$$c_2 NKID_{i,t} + c_3 DO1_{i,t} + c_4 D23_{i,t} + c_5 D45_{i,t} + c_6 D610_{i,t} \\ + c_7 D1115_{i,t} + c_8 \log wd_{i,t}] + c_9 \varepsilon_{i,t}$$

Tab.1 contains equations 9.2.1, 9.2.2 and 9.2.3 which estimate the employment probability equations 9.1.1, 9.1.2 and 9.1.3 for the 1,169 West German married women in our sample. They are aged from 25 to 54 and have continuously been married and took part to all the interviews of the German Panel from 1984 till 1988.⁷

The effect of other income of the household on women's current employment probability is negative as expected and the size of the coefficient is around 1 per cent.

In our employment probability equation both the number and the age of the youngest child in the family have a negative effect on their mother's employment probability.⁸ The presence of young children in the family has a discouraging effect on women's employment, and this effect is lower in equation 9.2.1 where we consider also the effect of expected gains in forward wages, than

⁷ For a detailed description of the sample of German married women used for estimation refer to Chapter 6 (Section 6.3.2).

⁸ This is in line with what we have found also for British married women: even when we control for the age of the youngest child in the family the variable "number of children" is significant (compare to the results shown in Chapter 8).

in equation 9.2.2 where we neglect this effect. Moreover the discouraging impact of the presence of young children in the family on married women's employment probability is lower in our employment probability equation than in those estimated on West German married women samples by Franz and Kawasaki (1981), Franz (1985), Holst et al. (1988), by Merz (1990) and by Gustafsson (1992).

As we show in the Appendix III to this Chapter, we have tested the hypothesis that $a_g = b_g$ and we cannot reject the null at the 5% level; this may be imputed to the little variation in the term expressing the gain in forward wages (wg), the term in which the two variables for wages differ.

By comparing our dynamic models (9.2.1 and 9.2.2) to the static one (9.2.3), one can see how the latter underestimates the effect of wages on the current employment probability of German married women. In fact, by performing the test on $a_g = c_g$ we have rejected the null at 5% level.⁹ We can therefore state that the exclusion of past work experience from the wage equation brings to a significant underestimation of the wage effect in the Probit for employment probability of German married women.

⁹ Refer to Appendix III to this Chapter for the tests.

TAB. 1			
Equations	9.2.1	9.2.2	9.2.3

Dependent Var.: Employment Probability (PAR) on 1,169 cases

Constant	-3.68 (- 9.89)	-2.69 (-11.64)	-2.00 (-3.09)
OY	-0.01 (- 1.75)	-0.02 (- 1.95)	-0.01 (-1.34)
NKID	-0.19 (- 2.34)	-0.20 (- 2.43)	-0.14 (-1.87)
D01	-0.53 (- 1.87)	-0.69 (- 2.43)	-0.40 (-1.45)
D23	-0.61 (- 2.86)	-0.78 (- 3.57)	-0.31 (-1.51)
D45	-0.41 (- 1.87)	-0.58 (- 2.61)	-0.17 (-0.80)
D610	-0.29 (- 1.63)	-0.42 (- 2.35)	-0.12 (-0.69)
D1115	-0.28 (- 1.82)	-0.33 (- 2.14)	-0.24 (-1.60)
log (wp + E _t wg)	1.63 (10.15)	-	-
log wp	-	1.61 (12.24)	-
log wd	-	-	0.80 (3.19)

log-likelihood	-727.91	-700.72	-777.49
$\chi^2(8)$	146.22	200.60	47.06
Significance			
level	0.32E-13	0.32E-13	0.28E-08

t-values in brackets

The χ square test of the Probit presented in Table 1 shows good fit for the models since for $\nu = 8$ at 0.05 level of significance the critical region is $\chi^2 > 15.51$.

9.3 - Estimation of Probit for the employment probability in full-time jobs of West German married women

It is interesting to analyse how the factors considered in the previous Section have different impact on the employment probability of West German married women in part-time and in full-time jobs. Therefore we have estimated Probit models similar to the ones reported in Tab.1 but for the probability of working in full-time and in part-time jobs in the week before 1987 interview.¹⁰

Amongst the more interesting results shown in Appendix IV to this Chapter, one can notice how the expected negative income effect on current employment probability is not significant, and it is positive in the part-time employment probability equations. Moreover the effect of predicted current wages and of the expected gain in forward wages is positive and significant in full-time and part-time employment probability equations, but it is significantly lower on the probability of working part-time than on the probability of working full-time. Both full-time and part-time static models estimated significantly understate the effect of predicted wages on current employment probability.¹¹

In Tab.4 below we report the results of the estimation of a bivariate Probit with sample selection for the probability of

¹⁰ The results are in the Appendix IV to this Chapter. Tab.2 contains equations (9.3.1), (9.3.2) and (9.3.3) which refer to the probability that the married women in our sample work full-time, while Tab.3 contains equations (9.4.1), (9.4.2) and (9.4.3) which refer to the employment probability of working part-time in week before 1987 interview.

¹¹ Refer to Appendix III for tests on this hypothesis.

working (PAR=1) and for the probability of working full-time (EMPF=1) in week before 1987 interview, as compared to the single equations. One cannot reject the null hypothesis of zero correlation between the disturbances of the two single Probit models as the Wald statistic computed shows.¹² This may be due to the fact that the same set of independent variables is on the right hand side of both full-time and employment probit.

If we assume that the age of the youngest child in the family and the wage enter only the employment choice and that once having decided to work, the only variables affecting the probability of working part-time or full-time are the number of children in the family and other income, the correlation coefficient between employment probability and probability of working full-time becomes significant as Tab.5 below shows.¹³

¹² In fact the Wald statistic (= 0.02) does not fall in the critical region given that $\chi^2(0.05, 1) = 3.84$.

¹³ In fact the Wald statistics ($=10.51^2 = 110.46$) falls in the critical region given that $\chi^2(0.05, 1) = 3.84$. Refer to Tab.5 for other statistics.

TAB.4		
	Single Equation	Bivariate
Employment Probability (PAR) on 1,169 cases		
Constant	-3.68 (- 9.89)	-3.72 (-10.54)
OY	-0.01 (- 1.75)	-0.01 (- 2.63)
NKID	-0.19 (- 2.34)	-0.19 (- 2.20)
D01	-0.53 (- 1.87)	-0.53 (- 2.01)
D23	-0.61 (- 2.86)	-0.63 (- 2.89)
D45	-0.41 (- 1.87)	-0.41 (- 1.83)
D610	-0.29 (- 1.63)	-0.29 (- 1.58)
D1115	-0.28 (- 1.82)	-0.28 (- 1.74)
log (wp + E _t wg)	1.63 (10.15)	1.65 (10.98)
full-time employment (EMPF) on 511 cases		
Constant	-3.58 (- 6.03)	-5.08 (- 0.95)
OY	-0.005 (- 0.48)	-0.01 (- 0.34)
NKID	-0.37 (- 2.45)	-0.38 (- 1.29)
D01	-0.42 (- 0.80)	-0.58 (- 0.97)
D23	-1.24 (- 3.10)	-1.30 (- 1.22)
D45	-0.35 (- 0.91)	-0.47 (- 1.19)
D610	-0.41 (- 1.33)	-0.47 (- 1.35)
D1115	-0.28 (- 1.03)	-0.35 (- 1.51)
log (wp + E _t wg)+1.51	(6.06)	+1.95 (1.74)
Correlation	0.0	0.70 (0.15)
log-likelihood	-727.91 -295.17	-1022.8
Wald Statistics		0.02
likelihood ratio		0.56
(t-values in brackets)		

PAR_{i,t} = 1 when woman works for a positive wage in week before 1987 interview

EMPF_{i,t} = 1 when woman works full-time in week before 1987 interview; = 0 when woman works part-time;

TAB. 5		
	Single Equation	Bivariate
Employment Probability (PAR) on 1,169 cases		
Constant	-3.68 (- 9.89)	-3.67 (-10.59)
OY	-0.01 (- 1.75)	-0.01 (- 2.52)
NKID	-0.19 (- 2.34)	-0.16 (- 2.21)
D01	-0.53 (- 1.87)	-0.54 (- 2.43)
D23	-0.61 (- 2.86)	-0.74 (- 4.15)
D45	-0.41 (- 1.87)	-0.43 (- 2.24)
D610	-0.29 (- 1.63)	-0.35 (- 2.21)
D1115	-0.28 (- 1.82)	-0.30 (- 2.21)
log (wp + E _t wg)	1.63 (10.15)	1.62 (10.97)
full-time employment (EMPF) on 511 cases		
	Single Equation	Bivariate
Constant	-0.04 (- 0.53)	0.54 (6.77)
OY	-0.003 (- 0.33)	0.44 (0.49)
NKID	-0.41 (- 6.21)	-0.20 (- 2.99)
Correlation	0.0	-0.83 (-10.51)
log-likelihood	-727.91 -318.11	-1029.0
(t-values in brackets)		
likelihood ratio		34.04
Wald Statistics		110.46
$\chi^2(0.5,1)$		3.84

As the statistics referred to in Tab.5 show, the bivariate model has good fit and one can reject the hypothesis of zero correlation between the disturbances of the two probit models.¹⁴ Therefore in Tab.6 below we report the partial derivatives of the

¹⁴ In fact both the likelihood ratio and the Wald statistic follow a χ^2 distribution, and the critical value of χ^2 at 0.05 significance level and 1 degree of freedom is 3.84.

function estimated in Tab.5 for the Bivariate employment probability equation.¹⁵

Tab.6 - EFFECT OF THE INDEPENDENT VARIABLES ON MARRIED WOMEN'S EMPLOYMENT PROBABILITY

Dependent Variables: PAR n=1,169

Right Hand Side Var.:

OY	-0.004*
NKID	-0.06*
D01	-0.21*
D23	-0.29*
D45	-0.17*
D610	-0.14*
D1115	-0.12*
log (wp + E _t wg)	+0.63*

(*) = significant at 95% level

PAR = 1 when woman works for a positive wage in week before 1987
1,t interview

OY = other household's income referring to year 1986;

NKID87= number of children aged less than 15 in 1987;

D01 = 1 if the youngest child in the family is aged less than 1;

D23 = 1 if the youngest child in the family is aged from 2 to 3;

D45 = 1 if the youngest child in the family is aged from 4 to 5;

D610 = 1 if the youngest child in the family is aged from 6 to 10.

D1115= 1 if the youngest child in the family is aged from 11 to 15

wp_{1,t} = current gross wage predicted by using equation (4).

wg = expected gain in forward wages:

$$= \exp(\log wp_{1,t+1}^o | PARF_{1,t} = 1) - \exp(\log wp_{1,t+1}^o | PARF_{1,t} = 0) =$$

$$= \exp(1 + 0.05 AGE_{1,t+1} - 0.0006 AGESQ_{1,t+1} + 0.068 EDUC_1) -$$

$$\exp(0.76 + 0.05 AGE_{1,t+1} - 0.0006 AGESQ_{1,t+1} + 0.06 EDUC_1)$$

We have used the wage equation (4) in order to predict forward

¹⁵ Tab.7 in Appendix V to this Chapter contains the partial derivatives of the single Probit equations reported in Tab.5.

wages.

Each additional child decreases married women's employment probability by 6%, and this effect is higher for German married women than it is for British married women (for the latter each additional child decreased their mothers' employment probability by 5%). The discouraging effect of the number of children aged from 2 to 15 decreases with the age of the youngest child in the family. If the youngest child in the family is aged from 2 to 3 his mother's employment probability decreases by 29% showing the highest discouraging effect amongst the dummies on the age of the youngest child in the family.

9.4 - Conclusions

A comparison of the results shown in Tab.6 with the partial derivatives of the employment probability function estimated on British data¹⁶ shows that the discouraging effect of the presence in the family of children aged less than 11 is higher in Great Britain than in West Germany. Consistently with the institutional factors discussed in Ch.5 when the youngest child in the family is aged 1 or less, the employment probability decreases by 68% for British married women and by 21% for West German married women. The higher discouraging effect for British mothers is probably to be imputed to the system of maternity leave at work in Great Britain¹⁷ which is less favourable to women than the system of leave in Germany. On the other hand if the youngest child in the family is aged from 11 to 15 his discouraging effect on mothers' employment probability is higher in West Germany than in the U.K. This may be due to the different organization of secondary schools in the two countries; in fact, as we have discussed in Ch.5, the organization of the school-day and the compatibility with mothers' working hours is better in Great Britain than in West Germany and this may justify the lower discouraging effect on women's employment probability.

According to the results shown in Tab.6 if $\log (wp + E_t wg)$ increases by one percent, the current employment probability will increase by 0.63. This positive and significant effect of predicted current wages (wp) augmented by the expected gain in forward wages ($E_t wg$) is consistent with the theoretical model presented in Chapter 4 and with its quasi-reduced form described in the Introduction to this Chapter.

¹⁶ For these derivatives refer to Tab.1 in Section 8.1.1.

¹⁷ For a description of it refer to Section 8.1.1 and to Ch.5. For tests on the difference between the coefficients refer to APP.VI.

APPENDIX I

Probit Model for West German married women employment probability in week before 1987 interview used to construct Heckman's λ

Equation (1) below has been used to construct the Heckman's λ used in the wage equations presented in Section 9.1, and in the demand for leisure equations presented in Section 9.2:

$$1) \text{ Prob (PAR=1)} = \Phi [-1.43 + 0.10 \text{ AGE} - 0.001 \text{ AGESQ} + 0.06 \text{ EDUC} - 0.04 \text{ EDUC} \\ (-1.26) \quad (1.48) \quad (-1.74) \quad (3.19) \quad (-2.57) \\ + 0.02 \text{ HUNOCC} + 0.25 \text{ SELFH} - 0.27 \text{ NKID87} - 0.22 \text{ D01} \\ (0.073) \quad (2.04) \quad (-4.75) \quad (-0.86) \\ - 0.16 \text{ D23} - 0.01 \text{ D45} - 0.005 \text{ D610}] \\ (-0.89) \quad (-0.06) \quad (-0.04)$$

PAR= 1 if woman was working with positive wage in week before 1987 interview; (mean employment rate in week before 1987 interview is 0.44, and in week before 1986 interview it is 0.43).

AGE= age of married women;

AGESQ= age of married women squared;

EDUC = years of education of women (constructed from stated level of education in year 1987);

EDUCH = level of education of husband (constructed from stated level of education in year 1987);

HUNOCC= 1 if husband is unemployed in week before 1987 interview;

SELFH=1 if husband is self employed in week before 1987 interview;

NKID87= number of children aged less than 15 in 1987;

D01 = 1 if the youngest child in the family is aged less than 1;

D23 = 1 if the youngest child in the family is aged from 2 to 3;

D45 = 1 if the youngest child in the family is aged from 4 to 5;

D610 = 1 if the youngest child in the family is aged from 6 to 10.

number of observations = 1,169 (t-values in brackets)

Φ := cumulative standard normal density function

The variables which significantly affect the employment probability of married women in the sample are, according to equation 1 above, years of schooling of wife (which positively affects her probability of being employed in week before 1987 interview), EDUC (women married to more educated men have lower probability to be working in week before 1987 interview), SELFH (women married to self-employed men are more likely to be employed, but this is probably related to the split type of taxation system in West Germany) and the number of children aged less than 15 in the household which, as expected, have a negative effect on married women's employment probability, while the dummies for the age

of the youngest child in the family are not significant.¹ However when we drop the variable NKID87, the dummies on the youngest child in the family have a significant effect on mothers' employment probability as equation (2) below shows:

$$(2) \text{ Prob (PAR=1)} = \Phi [-0.49 + 0.02 \text{ AGE} - 0.0004 \text{ AGESQ} + 0.06 \text{ EDUC} - 0.04 \text{ EDUCH} \\ (-0.44) \quad (0.44) \quad (-0.60) \quad (3.35) \quad (-2.76) \\ + 0.02 \text{ HUNOCC} + 0.22 \text{ SELFH} - 0.64 \text{ D01} \\ (0.07) \quad (1.81) \quad (-2.79) \\ - 0.55 \text{ D23} - 0.39 \text{ D45} - 0.30 \text{ D610}] \\ (-3.44) \quad (-2.49) \quad (-2.66)$$

As the above equation shows fertility dominates married women's employment probability, and the estimated coefficients for the dummies on the age of the youngest child decrease as the age of the youngest child in the family increases.

Equation (3) below shows that the employment probability of married women in our sample is highly related to their employment status in the previous year as the estimated coefficient for the variable EXP86 shows.² There is also a sensible change in the size and significance of the other coefficients.

(t-values in brackets)

$$(3) \text{ Prob (PAR=1)} = \Phi [-5.07 + 0.19 \text{ AGE} - 0.002 \text{ AGESQ} + 0.03 \text{ EDUC} - 0.01 \text{ EDUCH} \\ (-3.82) \quad (2.80) \quad (-2.69) \quad (1.43) \quad (-0.60) \\ + 0.19 \text{ HUNOCC} + 0.06 \text{ SELFH} - 0.10 \text{ NKID87} - 0.24 \text{ D01} \\ (0.75) \quad (0.43) \quad (-1.33) \quad (-0.78) \\ + 0.33 \text{ D23} + 0.37 \text{ D45} + 0.30 \text{ D610} + 1.94 \text{ EXP86}] \\ (1.56) \quad (1.82) \quad (1.95) \quad (20.58)$$

¹ A similar negative effect of the variable number of children under 18 on German married women's employment probability has also been found by Kaiser et al. (1989, p.18) in their analysis based on a subsample of the first wave of SEP data.

² This is also the case for the variables PAR86P (=1 if the woman was working part-time in week before 1986 interview) and PAR86F (=1 if she was working full-time) which, once introduced in the PROBIT have positive and significant coefficients which dominate the others, but it does not hold true for the constructed variable WORK86 which is a cohort proxy for past work experience.

APPENDIX II - WAGE EQUATIONS

In equation (5) below we have distinguished between past work experience in full time (EX86F) and in part-time jobs (EX86P).

$$\begin{aligned}
 (5) \logwg87 = & 0.70 + 0.05 \text{ AGE} - 0.0006 \text{ AGESQ} + 0.06 \text{ EDUC} \\
 & (1.06) \quad (1.65) \quad (-1.62) \quad (7.54) \\
 & + 0.34 \text{ EX86F} + 0.24 \text{ EX86P} + 0.09 \lambda \\
 & (5.89) \quad (4.31) \quad (0.47)
 \end{aligned}$$

$$R^2 = 0.16$$

$$n.\text{obs.} = 511$$

$\logwg87$ = log of gross hourly wage in 1987 deflated by using price indices base year 1984;

EDUC = years of schooling of women;

EX86P = 1 if woman was working part-time in week before 1986 interview;

EX86F = 1 if woman was working full-time in week before 1986 interview.

As one can see from the above equation both types of "learning by doing human capital" have a positive effect on the current level of gross wages of married women, but, as we expected, the effect of past work-experience in full-time jobs is higher.

However, turning to log of net wage equation (as the one shown in equation 6) one can see how only past work-experience in full-time significantly affects the current level of net wages:³

$$\begin{aligned}
 (6) \logwn87 = & -0.32 + 0.08 \text{ AGE} - 0.001 \text{ AGESQ} + 0.07 \text{ EDUC} \\
 & (-0.51) \quad (2.85) \quad (-2.75) \quad (8.08) \\
 & + 0.14 \text{ EX86F} + 0.04 \text{ EX86P} + 0.27 \lambda \\
 & (2.44) \quad (0.68) \quad (1.54)
 \end{aligned}$$

$$R^2 = 0.15$$

$$n.\text{obs.} = 511$$

$\logwn87$ = log of net hourly wage in 1987 deflated by using price

³ This result has also been found by Merz (1990, p.257) in his analysis on married women's labour supply based on the first wave of SEP and on retrospective information on part-time and full-time years of work. However the coefficients of past-work experience on current wage that we obtain are larger than the ones obtained by Merz, possibly because he uses the retrospective information on past work experience often subjected to recall errors and we use the information collected during 1986 survey.

indices base year 1984;
 EDUC = years of schooling of women;
 EX86P = 1 if woman was working part-time in week before 1986
 interview;
 EX86F = 1 if woman was working full-time in week before 1986
 interview.

Equation 7.1 below does not contain terms in past work experience and
 it has been used to predict the current level of wages in equation
 9.2.3 estimated in Section 9.2.

$$\begin{aligned}
 (7.1) \quad \log w_{87} = & 1.42 + 0.03 \text{ AGE} - 0.0004 \text{ AGESQ} + 0.06 \text{ EDUC} \\
 & (2.13) \quad (1.11) \quad \quad (-1.15) \quad \quad (6.84) \\
 & - 0.17 \lambda \\
 & \quad \quad (-0.89)
 \end{aligned}$$

$$R^2 = 0.11$$

$$n.\text{obs.} = 511$$

$\log w_{87}$ = log of gross hourly wage in 1987 deflated by using price
 indices base year 1984;

AGE = age of married women;

AGESQ = age of married women squared;

EDUC = years of schooling of women;

WORK86 = cohort constructed measure for past work experience.

APPENDIX III - TESTS ON THE EMPLOYMENT PROBABILITY EQUATIONS

1. The first test performed regards the equality between the coefficient of $\log (wp_{1,t} + E_t wg_{1,t+1})$ (1.63) in equation 9.2.1 (in Section 9.2) and the coefficient of $\log wp_{1,t}$ (1.61) in equation 9.2.2. (in Section 9.2).

$$H_0: a_g = b_g$$

In performing this test we have assumed that $\text{Cov}(a_g, b_g) = 0$. Therefore: S.E. $(a_g - b_g) = \sqrt{\text{var } a_g + \text{var } b_g} = 0.06$. Hence the 95% confidence limits for $(a_g - b_g)$ are $0.02 \pm 1.645 (0.06)$, i.e. $(-0.07, +0.11)$. Where 1.645 is the 5% probability point in the t tables with 1,160 degrees of freedom. Thus we cannot reject the null hypothesis of $a_g = b_g$ at the 5% level.

2. The second test regards the null hypothesis that:

$$H_0: a_g = c_g$$

Where a_g is the coefficient of $\log (wp_{1,t} + E_t wg_{1,t+1})$ (1.63) in equation 9.2.1 and c_g is the coefficient of $\log wd_{1,t}$ (0.80) in equation 9.2.3 (both equations are in Section 9.2). We have assumed that $\text{Cov}(a_g, b_g) = 0$. The 95% confidence limits for $(a_g - c_g)$ are $0.83 \pm 1.645 (0.10)$, i.e. $(0.677, +0.99)$. Thus we can reject the null hypothesis of $a_g = c_g$ at the 5% level.

3. The third test performed regards the equality between the coefficient of $\log (wp_{1,t} + E_t wg_{1,t+1})$ (1.90) in equation 9.3.1 and the coefficient of $\log wp_{1,t}$ (1.88) in equation 9.3.2 (both equations are in Appendix IV).

$$H_0: a_g = b_g$$

In performing this test we have assumed that $\text{Cov}(a_g, b_g) = 0$.

The 95% confidence limits for $(a_g - b_g)$ are $0.02 \pm 1.645 (0.05)$. Again we cannot reject the null hypothesis of $a_g = b_g$ at the 5% level.

4. Equality between the coefficient of $\log (wp_{1,t} + E_t wg_{1,t+1})$ (1.90) in

equation 9.3.1 and the coefficient of $\log wd_{1,t}$ (0.89) in equation 9.3.3 (both equations are in Appendix IV).

$$H_0: a_g = c_g$$

In performing this test we have assumed that $Cov(a_g, c_g) = 0$. The t_c is $= 2.97 > 1.645$. So we can reject the null in favour of the alternative that $a_g > c_g$ at 95% level of confidence.

5. Equality between the coefficient of $\log (wp_{1,t} + E_t wg_{1,t+1})$ (0.52) in equation 9.4.1 and the coefficient of $\log wd_{1,t}$ (0.10) in equation 9.4.3 (both equations are in Appendix IV).

$$H_0: a_g = c_g$$

In performing this test we have assumed that $Cov(a_g, c_g) = 0$. The t_c is $= 1.35 < 1.645$. So we cannot reject the null at 95% level of confidence

6. Equality between the coefficient of $\log (wp_{1,t} + E_t wg_{1,t+1})$ (1.90) in equation 9.3.1 and the coefficient of $\log (wp_{1,t} + E_t wg_{1,t+1})$ (0.52) in equation 9.4.1 (both equations are in Appendix IV).

$$H_0: a_g = \alpha_g$$

In performing this test we have assumed that $Cov(a_g, \alpha_g) = 0$. The t_c is $= 5.75 > 1.645$. So we can reject the null in favour of the alternative that $a_g > \alpha_g$ at 95% level of confidence. One can claim that the effect of current wages augmented by the expected gain in forward wages is greater in the full-time than in the part-time employment probability equation.

APPENDIX IV - PROBIT MODELS FOR FULL-TIME AND PART-TIME
EMPLOYMENT PROBABILITY

TAB. 2			
Equations	9.3.1	9.3.2	9.3.3
Dependent Var.: Full-time Employment Probability (PARF) on 1,169 cases			
Constant	-4.93 (-11.40)	-3.85 (-13.69)	-2.82 (-3.83)
OY	-0.01 (- 1.38)	-0.02 (- 1.53)	-0.01 (-1.04)
NKID	-0.28 (- 2.48)	-0.30 (- 2.57)	-0.20 (-1.93)
D01	-0.39 (- 1.10)	-0.51 (- 1.43)	-0.34 (-0.99)
D23	-1.31 (- 4.19)	-1.46 (- 4.65)	-0.99 (-3.26)
D45	-0.74 (- 2.48)	-0.92 (- 3.05)	-0.48 (-1.71)
D610	-0.55 (- 2.36)	-0.70 (- 2.95)	-0.37 (-1.70)
D1115	-0.40 (- 2.00)	-0.46 (- 2.25)	-0.38 (-2.00)
log (wp + E _t wg)	1.90 (10.37)	-	-
log wp	-	1.88 (12.32)	-
log wd	-	-	0.89 (3.14)
log-likelihood	-480.46	-451.20	-534.01
$\chi^2(8)$	581.07	259.74	94.12
Significance			
level	0.32E-13	0.32E-13	0.32E-13
t-values in brackets			

TAB. 3			
Equations	9.4.1	9.4.2	9.4.3

Dependent Var.: Part-time Employment Probability (PARP) on 1,169 cases

Constant	-1.82 (- 4.86)	-1.56 (- 6.78)	-0.87 (-1.27)
OY	+0.004 (0.47)	0.003(0.41)	0.005(0.60)
NKID	-0.12 (- 1.51)	-0.13 (- 1.56)	-0.11 (-1.34)
D01	-0.001 (- 0.004)	-0.05 (- 0.18)	-0.03 (0.11)
D23	+0.10 (0.34)	0.01 (0.06)	0.18 (0.86)
D45	+0.11 (0.49)	0.05 (0.22)	0.19 (0.86)
D610	+0.15 (0.83)	0.10 (0.57)	0.21 (1.17)
D1115	+0.14 (0.88)	0.12 (0.78)	0.15 (0.95)
log (wp + E _t wg)	0.52 (3.26)	-	-
log wp	-	0.54 (4.27)	-
log wd	-	-	0.10 (0.37)

log-likelihood	-673.39	-669.57	-678.64
$\chi^2(8)$	13.62	21.26	3.13
Significance			
level	0.09	0.006	0.93

t-values in brackets

The χ square test of the Probit models estimated in Table 2 shows good fit for the models since for $\nu = 8$ at 0.05 level of significance the critical region is $\chi^2 > 15.51$, while only equation 9.4.2 shows a good fit amongst the ones in Tab.3.

APPENDIX V -
EFFECT OF THE INDEPENDENT VARIABLES ON MARRIED WOMEN'S EMPLOYMENT
PROBABILITY

Tab.7 - EFFECT OF THE INDEPENDENT VARIABLES ON MARRIED WOMEN'S
EMPLOYMENT PROBABILITY

Dependent Variables:	PAR n=1,169	EMPF n = 511
Right Hand Side Var.:		
OY	-0.004	-0.002
NKID	-0.07 [*]	-0.14 [*]
D01	-0.21	-0.16
D23	-0.24 [*]	-0.46 [*]
D45	-0.16	-0.13
D610	-0.11	-0.15
D1115	-0.11	-0.10
log (wp + E _t wg)	+0.64 [*]	+0.56 [*]

(*) = significant at 95% level

PAR_{i,t} = 1 when woman works for a positive wage in week before 1987
interview

EMPF_{i,t} = 1 when woman works full-time in week before 1987
interview; = 0 when woman works part-time;

OY = other household income referring to year 1986;

NKID87= number of children aged less than 15 in 1987;

D01 = 1 if the youngest child in the family is aged less than 1;

D23 = 1 if the youngest child in the family is aged from 2 to 3;

D45 = 1 if the youngest child in the family is aged from 4 to 5;

D610 = 1 if the youngest child in the family is aged from 6 to 10.

D1115 = 1 if the youngest child in the family is aged from 11 to 15.

wp_{i,t} = current gross wage predicted by using equation (4) above;

wg = expected gain in forward wages:

$$= \exp(\log wp_{i,t+1}^e | PARF_{i,t} = 1) - \exp(\log wp_{i,t+1}^e | PARF_{i,t} = 0) =$$

$$= \exp(1 + 0.05 \text{ AGE}_{i,t+1} - 0.0006 \text{ AGESQ}_{i,t+1} + 0.068 \text{ EDUC}_i) - \\ \exp(0.76 + 0.05 \text{ AGE}_{i,t+1} - 0.0006 \text{ AGESQ}_{i,t+1} + 0.06 \text{ EDUC}_i)$$

where we have used the wage equation (4) in order to predict forward wages.

Each additional child decreases married women's employment probability by 7%, and this effect is higher for German married women than it is for British married women (for the latter each additional child decreased their mothers' employment probability by 5%). The discouraging effect of the number of children aged less than 15 is higher on full-time employment probability (each additional child decreases mothers' employment probability in full-time jobs by 14%). If the youngest child in the family is aged from 2 to 3 his mother's employment probability decreases by 24% and her employment probability in full-time jobs decreases by 46% showing the highest discouraging effect amongst the dummies on the age of the youngest child in the family.

APPENDIX VI - TESTS ON THE EMPLOYMENT PROBABILITY AND WAGE EQUATIONS

1. Comparison of coefficients in the employment probability equations for West German married women (Tab.5, Section 9.3) and for U.K. married women (equation 1, Section 8.1.1). The two equations differ in the samples and variables used. Moreover, the equation for West German married women's employment probability comes from a Bivariate estimation. So we cannot claim that the tests conducted in this Appendix are conclusive.

1.1. Equality between the coefficient of D01 in equation 1 for the employment probability of British married women (-1.73) (S.E. 0.16)(a) and the coefficient of D01 in (Tab.5) (b)(-0.54) (S.E. 0.22).

$H_0: a = b$ against $H_a: a < b$

In performing this test we have assumed that $Cov(a,b) = 0$.

The t_c is $= -4.41 < -1.645$. So we can reject the null in favour of the alternative that $a < b$ at 95% level of confidence. The presence of a youngest child aged less than 1 in the family has a greater discouraging effect on the employment probability of British married women than on the employment probability of West German married women.

1.2. Equality between the coefficient of D23 in equation 1 for the employment probability of British married women (-1.47) (S.E. 0.16)(a) and the coefficient of D23 in (Tab.5) (b)(-0.74) (S.E. 0.18)

$H_0: a = b$ against $H_a: a < b$

In performing this test we have assumed that $Cov(a,b) = 0$.

The t_c is $= -3.04 < -1.645$. So we can reject the null in favour of the alternative that $a < b$ at 95% level of confidence. The presence of a youngest child aged from 2 to 3 in the family has a greater discouraging effect on the employment probability of British married women than on the employment probability of West German married women.

1.3. Equality between the coefficient of D1118 in equation 1 for the employment probability of British married women (-0.03) (S.E. 0.14) (a) and the coefficient of D1118 in (Tab.5) (b)(-0.30) (S.E. 0.14).

$H_0: a = b$ against $H_a: a > b$

In performing this test we have assumed that $Cov(a,b) = 0$.

The t_c is $= 1.35 < 1.645$. So we cannot reject the null in favour of the alternative that $a > b$ at 95% level of confidence. However we should notice that the variable D1118 in the employment probability equation for British married women is not significant, whereas the dummy for children aged from 11 to 15 in the West German married women's employment probability equation (Tab.5) has a significant discouraging effect.

2. Comparison of coefficients in the wage equations for West German married women (equation 4, Section 9.1) and for U.K. married women (equation 3, Section 8.1.2). The two equations differ in the samples and variables used so we cannot claim that the tests conducted in this Appendix are conclusive.

2.1. Equality between the coefficient of EDUC in the wage equation for British married women (0.06) (S.E. 0.010)(a) and the coefficient of EDUC in the wage equation for West German married women (0.06) (S.E. 0.008) (b).

$$H_0 : a = b$$

In performing this test we have assumed that $\text{Cov}(a,b) = 0$.

The t_c is $= 0 < 1.645$. So we cannot reject the null hypothesis that the effects of education on gross wages in the two equations differ at 95% level of confidence.

2.2. Equality between the coefficient of the cohort proxy for individual past work experience in the wage equation for British married women (0.11) (S.E. 0.05)(a) and the coefficient of the individual past work experience in the wage equation for West German married women (0.24) (S.E. 0.055) (b).

$$H_0 : a = b \quad \text{against} \quad H_a : a < b$$

In performing this test we have assumed that $\text{Cov}(a,b) = 0$.

The t_c is $= -1.86 < -1.645$. So we can reject the null hypothesis in favour of the alternative at 95% level of confidence.

CHAPTER 10 - CONCLUSIONS

Standard dynamic models of female labour supply generally underestimate the number of married women who "stay in the labour market". In Chapter 2 we have surveyed these models and stressed how one of their disadvantages is that they assume that current labour supply behaviour is not affected by the individual past work experience, this arises because they assume intertemporal separability of the lifetime utility function and of the lifetime budget constraint.

In Chapter 3 we have shown how the implications of these two assumptions have been rejected by empirical analyses which provide evidence in favour of the existence of persistence effect in employment both for male and for female labour supply. We have also noticed the problem of identifying the different sources of this persistence effect which can arise either by introducing nonseparable preferences with a lifetime separable budget constraint or by keeping the assumption of separable preferences and by relaxing the assumption of a lifetime separable budget constraint.

Models which relax the assumption of intertemporal separability of the lifetime utility function have been surveyed in Section 3.1.2, where we have also analysed the factors leading to the rejection of this assumption (amongst them habit formation, job search activity, contracts). In Section 3.1.3 we have surveyed those models of life cycle labour supply which introduce a nonseparable lifetime budget constraint by relaxing the assumption of wage exogeneity.

On the basis of the evidence surveyed in Section 3.1.3, we expect that by introducing past work experience as an explanatory variable in the wage equation one gets a more continuous work-profile for married women over the life cycle, that child status variables will have a lower discouraging effect than in

models which neglect past work experience and that there is no habit persistence effect. We also expect that wage endogeneity will bring in the demand for leisure equation an extra term accounting for the gain in forward wages and employment of the current decision of working.

The evidence surveyed in Section 3.2 on the effects of fixed costs of working on labour supply in a standard and in a dynamic setting, leads us to introduce these components in the life cycle model presented in Chapter 4.

The evidence surveyed in Chapter 2 has shown that the standard Frisch demand model of labour supply (with the assumptions of intertemporal separability of the lifetime utility function and budget constraint) performs better when applied to the analysis of married women's labour supply behaviour over their life cycle than when applied to the analysis of prime age men's labour supply. In fact, the variation of labour supply over their life cycle is greater for married women than for prime age men, and the part of this variation explained by the standard Frisch demand model is greater for married women than for men. This better fit of the Frisch demand model on the analysis of married women's labour supply together with the evidence (surveyed in Chapter 1 and 5) on the dramatic changes occurred in the level and life cycle profiles of married women's labour supply over recent decades, brought us to choose to apply a Frisch demand model of labour supply to the analysis of the labour supply behaviour of this component of the population.

However, in the light of the failure of the standard Frisch demand model presented in Chapter 2, to explain the observed persistence effect in the employment behaviour over the life cycle both for men and for women, and because of the vast evidence against the assumption of wage exogeneity for women we have modified the basic structure of the model by relaxing the assumption of intertemporal separability of the lifetime budget

constraint via wage endogeneity in the "wage-experience dynamic model of labour supply" presented in Chapter 4 and which has been estimated in the Second Part of this thesis.

The main implication of the inclusion of past work experience as explanatory variable in the wage equation, as far as the demand for leisure equation is concerned, is that forward terms in leisure and in wages enter the demand for leisure even if one does not impose nonseparable preferences. According to our model, when the woman decides on the allocation of time between work in the labour market and leisure, she considers also the effect that an additional hour of work at time t has on her future wages given that she decides to work in the future. In the standard dynamic labour supply model surveyed in Chapter 2 the expected increase in wages will bring about a reduction in current hours of work via intertemporal substitution. In our wage-experience model, on the other hand, the total effect of an increase in forward wages is uncertain because it is made up of the usual negative substitution effect (which produces a decrease in current hours of work) and of the positive experience effect (according to the latter, higher forward wages are related to higher current hours of work).

In Chapter 4 we have discussed also the implications of introducing in our model fixed costs of working connected with the presence in the family of young children. Fixed costs of entry in the labour market determine the number of reservation hours for the woman, and, if the desired hours of work are less than the reservation hours she will not enter the labour market. The marginal utility of wealth-constant effect of fixed costs of working on current hours of work will be negative if the woman decides to work a positive number of hours, and equal to zero if she does not work at time t , while, as shown in Section 4.2, the marginal utility of wealth - variable effect on married women's labour supply is certainly positive. Therefore the net effect of fixed costs incurred by a woman with a child aged i at time t is

ambiguous. However, in the application of our model to the available data we have not tested this effect given the lack of data on money costs incurred by the family for each child in the household. We have only taken into account fixed time costs connected with the presence of young children in the family, by including the number of children aged less than 15 and the age of the youngest child in the family as arguments of the utility function.

We have compared our model of labour supply to other life cycle models of labour supply in Section 4.3. We are aware of the strong assumptions that still are maintained in our model. Amongst them the assumptions of: perfect capital markets, separable preferences over time and within period, lack of preference interdependence between husband and wife,¹ exogeneity of fertility choices, no fixed money costs of working in the budget constraint, no aggregate shocks.

Some of the above mentioned assumptions (like perfect capital markets or no fixed money costs in the budget constraint) have been kept because of the lack of information on them in the data set used for the estimation of our model. Given the functional form chosen, within period separability between consumption and leisure could have been relaxed only by assuming an even less attractive assumption: homothetic preferences. The latter assumption would have implied for instance unitary within-period full-income elasticities.

Notwithstanding the evidence (that we have surveyed in Chapter 3) against some of the assumptions maintained by our model, we have not relaxed them also in order to estimate the model in its Structural Form, as we have done in Chapter 8 with UK

¹ For an analysis which introduces habit formation and preference interdependence in a family labour supply model refer to Kapteyn and Woittiez (1990). By applying their model to a sample of Dutch families they find lack of strong preference interdependence but evidence of habit formation.

data. In short, we had to evaluate the need of making the model more close to reality (and this would have led to relax most of the assumptions still kept by our model) against the need of estimating the model in its Structural form rather than only in its Reduced Form.

In the second part of the thesis we have carried out empirical analyses of the model presented in Chapter 4, together with an analysis on wages and earnings mobility by gender.

We have analysed married women's labour supply in the U.K. and in West Germany. In both Great Britain and West Germany female labour supply has been increasing in the last decade. Married women aged from 20 to 60 has been the most dynamic component of female labour supply in both countries. However the two countries differ in the level of married women's participation rates which are higher in the U.K. than in FRG (in 1986 married women's participation rate was 50% in the UK while the participation rate of West German married women was 42.5% in 1985). This can be imputed to several factors which have been discussed in Chapter 5, amongst them:

- the higher diffusion of part-time work in the U.K. than in West Germany;
- the higher number of jobs offered by the Service Sector in the U.K.;
- the "split system" of taxation in West Germany, which has been found to discourage married women's labour supply.

On the other hand the system of childcare facilities in the two countries made us expect that married women's labour supply should be higher in West Germany than in the U.K. when the child is in pre-school age. Mothers' participation in the labour market work should be higher in the U.K. than in West Germany when the child is in school-age given the higher compatibility of schooling

hours and working hours in the U.K. than in West Germany.²

In both countries retrospective surveys have shown how married women's work-profile is changing over the life cycle, with a decreased number of women, amongst the younger cohorts, who interrupt their career during childbearing and childrearing years and with a tendency to shortening the period out of the labour force. Notwithstanding the changes occurred in married women's level of participation rates and work-profile, there are only a few dynamic models on female labour supply estimated by using U.K. and German data as the survey presented in Chapter 5 (Section 5.2) shows. It is therefore interesting to estimate our wage-experience model of labour supply on British and German data.

The lack of dynamic analyses on female labour supply in the two countries investigated is partly to be imputed to the lack of panel data or to their recent acquisition. One of the aims of our research was to develop a technique which would allow one to estimate a dynamic model of labour supply also in countries where individual households' panel data are not available. This has brought us to construct a cross section augmented by cohort proxies by using Family Expenditure Survey data for the U.K. where individual households' panel data were not available (this technique has been described in Chapter 6 and summarized below).

In particular, the estimation of our wage-experience model of labour supply requires terms in past and forward work-experience and in forward wages. In order to construct past work experience when, as in the case of UK Family Expenditure Survey (FES) data, individual observations on past and forward work experience are not available, we have computed the mean employment rates in 1982

² On the other hand the maternal leave system and the type of pre-school child care facilities available in West Germany are more favourable than in the U.K. for mothers' labour supply.

for married women for each cohorts, according to the presence of young children in the household and to the age of the youngest child in the family. This procedure gave us a matrix with 35 elements.

The same procedure has been followed in order to compute a cohort proxy for individual's forward work experience. The cohort proxy for individual's forward wages has been constructed by computing the mean marginal wage of working married women in year 1984 according to their cohort, their level of education and the region where their household lives. This computation gave us a matrix of 63 cells.

We have followed a similar technique also by using the German SocioEconomic Panel in order to compare the results of the estimation on one wave of the Panel enriched by using individual panel data observations on forward and lagged explanatory variables with the results obtained by using cohort proxies for forward and lagged explanatory variables for the same country.

Before turning to the estimation of our wage-experience dynamic model on labour supply to British and German data, we have carried out an analysis on wages and earnings mobility by gender in West Germany, by using the German SocioEconomic Panel. This analysis adds more information on a topic (earnings mobility by gender) which has been rarely investigated particularly in West Germany.

The wage and earnings mobility analysis for German workers carried out in Chapter 7, has confirmed our hypothesis, that people characterized by a discontinuous work-profile have higher downward earnings mobility than people having a continuous work-profile for the period considered. However, we have noticed how the analysis of earnings mobility does not distinguish between downward earnings mobility caused by downward wages mobility and downward earnings mobility caused by a decrease in hours of work. We have also noticed how the analysis of wages mobility is

restricted by the existence of measurement errors in the constructed hourly wage variable.

In Chapter 7 we have also found that gross earnings of married women having a broken work-profile are significantly more transitory than those of women in the constant sample. Moreover women's earnings mobility is lower than their husbands' earnings mobility for people continuously at work from 1984 to 1988, a result which is in line with previous evidence on British data.

Consistently with the analysis by Hart (1976) based on British working men data, we have also found that earnings mobility is higher the longer is the time interval considered for both men and women having a continuous work profile from 1984 to 1988 (the "constant sample").

In Chapter 8 we have estimated our wage-experience dynamic model on married women's labour supply with the data set constructed by means of Family Expenditure Survey data (years 1982, 1983, 1984) and by following the procedure described above and in Chapter 6. FES data contained also information on the household's consumption and this, as shown in Chapter 4 and in Section 6.4, allowed us to estimate the Structural form of the model by following a 5 step procedure:

- 1) Probit on the employment probability of married women in the sample;
- 2) estimation of a log wage equation corrected for selection bias;
- 3) estimation of log of Consumption equation, used to substitute the marginal utility of initial wealth term in the following steps;
- 4) 2 Stage least squares estimation of a log linear approximation of the structural form demand for leisure equation. In this stage we have also tested for the significance of the predicted against the actual measures of wages and consumption;
- 5) 2 Stage least squares estimation of the structural form model for the demand of leisure.

As one can see by comparing the model presented in Chapter 4 and the model estimated in Chapter 8, we have tried to keep the econometric model estimated as close as possible to the theoretical "wage-experience model of female labour supply". This made us choosing a very simple wage equation in the second step of the estimation. Actually by adding demand side explanatory variables in the wage equation (as we have done in unreported regressions), we would have obtained a better fit but the estimated wage equation would have been different from the one implied by the theoretical model.

The estimation of the Probit for married women's employment probability has shown that the variables number, presence and age of young children in the household dominate their mothers' employment probability. Their size has shown that the employment probability of married women is lower the less is the youngest child's age. Moreover, differently from other studies on female labour supply in the U.K., even when we have controlled for the age of the youngest child in the family, the variable "number of children" (NKIDS) was still having a discouraging and significant effect on married women's employment probability, each additional child decreasing the employment probability by 0.05. On the whole the presence of a discouraging effect of young children on their mothers' employment probability is a result predicted both by economic theory and by previous analyses on female labour supply in the U.K. This is also predictable if one takes into account the system of maternal leave and of child care facilities existent in the U.K. which has been found to discourage women's continuous work profile over their lives.

Amongst the other variables included in the Probit model estimated, one must stress that the sign of the coefficient of husband's employment status is in favour of the existence of a discouraged worker effect, or, as we have discussed in Chapter 8 (Section 8.1.1) of the existence of a system of unemployment

benefit which discourages labour supply of unemployed men's wives.

The estimated wage equation showed a clear positive effect of the cohort constructed past work experience variable on the current level of wages. The rate of return of past employment on married women's gross wage is around 11%, whereas the rate of return of schooling on current gross wages is 6% as shown in Section 8.1.2.

The estimation of the log of consumption equation allowed us to use predicted consumption in the estimation of the model carried out in the last two steps of our procedure.

The estimation of the structural form model of the demand of leisure by means of 2 stage least squares has shown how the discouraging effect of young children on their mothers' labour supply was lower in the structural form than in the Probit model estimated in the first step. The variable "number of children" in the household was no longer significant in the log demand of leisure estimated in the final step, and the size and significance of the coefficients of the dummies on the age of the youngest child in the family were in line with the institutional factors at work in the U.K.. Women stop working during childbearing and when the child is young, given the system of maternity leave and the lack of affordable childcare facilities, and go back to work when their youngest children are older than 4, but they return to part-time work rather than full-time, in order to match their reduced and more flexible working hours with the time-table of schools for their children.

Moreover the estimation carried out in step 5 (Section 8.2 of Chapter 8) gave us an estimate for the intertemporal substitution elasticity, which suggests us that for a 1% increase in the relative price of leisure between two years, given by our augmented wage term (which includes also forward terms in wages and employment) there will be around 0.16% decrease in the leisure consumed by each married woman in the sample in those years.

As we have stressed in Section 8.2, a comparison of the

estimates of the structural parameters of our model with those obtained by other models is difficult, because of the differences in model specification, samples and variables used. The results of the sensitivity analysis carried out in Section 8.2, where we have compared two different models estimated on the same data set for the U.K., showed us how, by neglecting the effect of past work experience on current wages one gets a bigger and more significant estimate for the intertemporal elasticity of substitution of married women's labour supply which implies that married women's labour supply is more transitory over time when one assumes wage exogeneity.

The availability of individual households' panel data for Germany provided us individual data on past and forward work experience and on forward wages together with current information necessary to estimate our wage-experience model of married women's labour supply. However, the lack of data on household's consumption did not allow us to estimate the structural form model of the demand of leisure, and we were left with the estimation of a quasi-reduced form of our wage-experience model.

We have started by estimating a log wage equation (corrected for selection bias) which included, amongst the explanatory variables, past work-experience together with its interaction with the level of education attained by each woman in the sample. The return of schooling is 6% as we have found for the U.K., however to this positive direct effect of schooling on wages one should add the positive indirect effect of education through past work experience. In fact, contrary to what happened in the estimation of the wage equation carried out on British data, we have found that the interaction term between past work experience and education has a positive and significant effect on the current level of wages of German married women. This suggests that the effect of past work experience on current level of wages differs according to the level of education attained, i.e. that a higher

level of education enhances the human capital accumulation of past work experience (this has been found only for full-time jobs).

The return of individual past work experience on current gross wages is 24% a much higher effect than the one that we have found by using British data. However one must notice the possible endogeneity of individual past work experience in the wage equation and we should stress that the cohort proxy constructed with German data for past work experience turned out to be not significant in the wage equation.

The existence of a positive and significant effect of individual past work experience on current level of wages implies that the effect of current employment decision on forward wages (and therefore on forward employment probability) enters the payoff functions for current employment probability that we have estimated in Section 9.2.. The effect of wages on current employment probability was higher when we have taken into account the effect of past work experience on wages than when we have neglected this wage-experience effect as the sensitivity analysis carried out in Section 9.2 has shown.

We have estimated also Bivariate Probit models for the probability of being employed and of being employed in full-time rather than in part-time jobs having decided to work for a positive number of hours. When we have excluded from the full-time employment probability equation the wage term and the dummies for the age of the youngest child in the family, we have found that the correlation coefficient between the employment probability and the probability of working full-time was significantly different from zero.

A comparison of the results shown in Section 9.3 for the Bivariate Probit estimated on German Panel data with the partial derivatives of the employment probability function estimated on British data has shown that the discouraging effect of the presence in the family of children aged less than 11 is higher in

Great Britain than in West Germany. On the other hand if the youngest child in the family is aged from 11 to 15 his discouraging effect on mothers' employment probability is higher in West Germany than in the U.K. These results are consistent with the institutional factors discussed in Ch.5.

According to the results shown in Section 9.3 if the augmented wage (which includes the gain in forward wages connected with current employment probability) increases by one percent, the current employment probability will increase by 0.63. This positive and significant effect of current predicted wages augmented by the gain in the expected forward wages is again consistent with the theoretical model presented in Chapter 4 and with its quasi-reduced form.

The evidence provided by the empirical analyses performed in the Second Part of the Thesis is on the whole consistent with the theoretical model presented in Chapter 4. Particularly we have found that past work experience has a significant effect on current wages both for British and for German married women, and we have shown how neglecting the wage-experience relationship in the estimation of a dynamic model on married women's labour supply can lead to an underestimation of the wage effect on current employment decision (Chapter 9) and to an overestimation of the intertemporal substitution elasticity (Chapter 8). We have also shown how wages and earnings mobility changes according to the type of work-profile of the German workers analysed in Chapter 7, and we have developed a technique to apply dynamic models on labour supply to countries where individual households' panel data are not available that we have used in the estimation of our wage-experience model to British data.

The evidence provided shows that current decisions on employment affect forward employment behaviour and forward wages of women. This can imply that policies which encourage a more

continuous work-profile for women (like provisions of child-care facilities at lower cost for double workers families, or training for women who exit the labour force in order to make their return to employment quicker and to reduce the disadvantage implied by their exit) are more effective in promoting higher probability of women of staying in the labour force and in reducing wage differentials by gender.

REFERENCES

Altonji, J.G. (1982) "The intertemporal substitution model of labor market fluctuations: an empirical analysis", in Review of Economic Studies, 49, pp.S783-S824.

Altonji, J.G. (1986) "Intertemporal substitution in labour supply: evidence from microdata" Journal of political Economy, 94 pp.S176-S215.

Altug, S. and Miller, R.A. (1991), "Human Capital, Aggregate shocks, and Panel Data estimation", Institute for Empirical Macroeconomics, Federal Reserve Bank of Minneapolis, University of Minnesota, Discussion Paper 47.

Arellano, M. and Bover, O. (1988), "Estimating dynamic limited dependent variable models from Panel data with an application to Female labour supply", Preliminary and incomplete draft.

Arellano, M. and Meghir, C. (1990), "Labour supply and hours constraints" in Florens, J.P. et al. (eds.) (1990) Ch.9, pp.213-230.

Ashenfelter, O. and Heckman, J. (1974), "The estimation of income and substitution effects in a model of family labour supply", Econometrica, 42, January, pp.73-85.

Ashenfelter, O. and Layard, R. (eds) (1986), "Handbook of Labor Economics", Amsterdam, North-Holland.

Atkinson, A.B., Bourguignon, F. and Morrisson, C. (1991), "Empirical studies of earnings mobility", Paris, Delta, Documents de Travail, No.91-14.

Atkinson, A.B. and Micklewright, J. (1983), "On the reliability of income data in the Family Expenditure Survey 1970-77", in Journal of the Royal Statistical Society, Series A, 146 (1), pp.33-61.

Ballard, B. (1984), "Women part-time workers: evidence from the 1980 Women and Employment Survey", in Employment Gazette, vol 92, No.9, Sept., pp.409-416.

Becker, G. (1975) "The allocation of time over the life cycle", in Ghez and Becker, 1975, pp.83-132.

Berg, S.V. and Dalton, T.R. (1977), "UK labour force activity rates: unemployment and real wages", in Applied Economics, 9,

no.3, pp.265-270.

Blinder, A.S. and Weiss, Y. (1976) "Human Capital and Labor Supply: a synthesis", *Journal of Political Economy*, vol.84, no.3., pp.449-472.

Blossfeld, H.P. (1990), "Changes in Educational Opportunities in the Federal Republic of Germany. A longitudinal Study of cohorts born between 1916 and 1965", *European University Institute Working Paper in Political and Social Sciences*; SPS 90/4.

Blundell, R. (1987) "Econometric approaches to the specification of life cycle labour supply and commodity demand behaviour", in *Econometric Reviews*, 6(1), pp.103-165.

Blundell, R., Fry, V. and Meghir, C. (1990), "Preference Restrictions in Microeconomic Models of Life-Cycle Behaviour under uncertainty" in *Florens, J.P. et al. (eds.) (1990) Ch.2*, pp.41-54.

Blundell, R., Ham, J.C. and Meghir, C. (1987), "Unemployment and female labour supply", in *Economic Journal*, 97, pp.44-64.

Blundell, R., Ham, J.C. and Meghir, C. (1988), "Unemployment, discouraged workers and female labour supply", *UCL discussion paper no.88-19*.

Blundell, R. and Meghir, C. (1990), "Panel data and life-cycle models", in *Hartog, J., Ridder G., and Theeuwes, J. (eds.)*, pp.231-252.

Blundell, R. and Walker, I. (1986), "A life-cycle consistent empirical model of family labour supply using cross-section data", in *Review of Economic Studies*, LIII, pp.539-558.

Bover, O. (1986) "Some dynamic life-cycle models of labour supply estimated from panel data" *University of Oxford Applied Economics discussion Papers*, No.13

Browning, M.J. (1982) "Profit function representations for consumer preferences", *Bristol University Discussion Paper*, No.82/125.

Browning, M.J. (1988) "Interpreting the results of empirical analyses of intertemporal allocation: an Identification Problem", mimeo, Dept. of Economics, McMaster University.

Browning, M.J., Deaton, A.S. and Irish, M. (1985) "A profitable Approach to labour supply and commodity demands over the life cycle" *Econometrica*, 53, pp.503-544.

Chamberlain, G. (1984), "Panel data", Ch.22 in Griliches and Intriligator, eds., Handbook of Econometrics, Vol.II, Amsterdam, North Holland.

Clark, K.B. and Summers, L.H. (1982), "Labour force participation: timing and persistence", in Review of Economic Studies, 49, Supplement, pp.825-844.

Cogan, J.F. (1980) "Labour supply with fixed costs of labour market entry" in Smith, J.P. (ed.), Female labour supply: theory and estimation, Princeton University Press.

Cogan, J.F. (1981) "Fixed costs and labour supply", in Econometrica, 49 (4), pp. 945-964.

Creedy, J. (1976), "Income concept, time period and changes in earnings 1963-1973", University of Reading Discussion Papers in Economics, no.76.

Daeubler-Gmelin, H. (1980), "Equal Employment Opportunity for Women in West Germany Today", in Ratner (ed.), (1980), Ch.15, pp.329-349.

Daniel, W.W. (1981), "Employers' experience of Maternity Rights Legislation", in Employment Gazette, July, pp.296-301.

Deaton, A. (1974), "A reconsideration of the empirical implications of additive preferences", in Economic Journal, 84, pp.338-348.

Deaton, A. (1985), "Panel data from time series of cross-sections", in Journal of Econometrics, 30, pp.109-126.

Deaton, A. and Muellbauer, J. (1986), "Economics and consumer behavior", Cambridge, Cambridge University Press.

Department of Employment and Office of Population Censuses and Survey (1984), "Women and Employment: A lifetime perspective", London, HMSO.

Dex, S. (1984a), "Women's work histories: an analysis of the Women and Employment Survey", Department of Employment Research Paper, no.46, London, HMSO.

Dex, S. (1984b), "Women's occupational profiles: evidence from the 1980 Women and Employment Survey", in Employment Gazette, Dec., pp.545-549.

Dex, S. and Puttick, E. (1988), "Parental Employment and family formation", in Hunt, A. (ed.) (1988), Ch.6, pp.123-149.

Dex, S. and Shaw, L. (1986), "British and American women at work:

Do equal opportunities policies matter?", London, MacMillan.

Drengel, A. (1987), "Federal Republic of Germany" in Pechman, J.A. (ed.) 'Comparative tax systems', Tax Analysts, Arlington, Virginia.

Duncan, O.D. and Duncan, B. (1955a), "A methodological analysis of segregation indexes", in American Sociological Review, 20, pp.200-217.

Duncan, O.D. and Duncan, B. (1955b), "Residential distribution and occupational stratification", in American Journal of Sociology, 60, pp.200-217.

Economic Commission for Europe (ECE), (1985), "The economic role of women in the ECE Region, Developments 1975/85", New York, United Nations.

Eckstein, Z. and Wolpin, K.I. (1989), "Dynamic labour force participation of married women and endogenous work experience", in Review of Economic Studies, 56, pp.375-390.

Elias, P. (1979), "A time-series analysis of the labour force participation of married women in the UK 1968-1975", MRC Discussion Paper, University of Warwick.

Elias, P. (1988), "Family formation, occupational mobility and part-time work", in Hunt, A. (ed.) (1988), Ch.4, pp.83-104.

Elias, P. and Main, B. (1982), "Women's Working Lives: Evidence from the National Training Survey", Coventry: Institute for Employment Research, University of Warwick.

Equal Opportunities Commission (EOC), (1987), "Women and men in Britain, a statistical profile", London, HMSO.

Erler, G. (1988), "The German Paradox. Non-feminization of the Labor force and Post-industrial Social Policies", in Jenson, J. Hagen, E. and Reddy, C. (eds.), (1988), Ch.13.

Fisher, M.R. (1971) "The economic analysis of labour", London: Weidenfeld and Nicolson.

Florens, J.P., Ivaldi, M., Laffont, J.J. and Laisney, F. (eds.) (1990), "Microeconometrics: Surveys and Applications", Oxford, Basil Blackwell.

Franz, W. (1985), "An Economic analysis of female work participation, education, and fertility: theory and empirical evidence for the Federal Republic of Germany", in Journal of Labor Economics, Vol.3, No.1, Part 2, pp.218-234.

Franz, W and Kawasaki, S. (1981), "Labor supply of married women in the Federal Republic of Germany: Theory and Empirical Results from a new Estimation procedure", in Empirical Economics, Vol.6, pp.129-143.

Frisch, A. (1932), "New Methods of measuring Marginal Utility", J.C.B. Mohr, Tubigen.

Galler, H.P. (1988), "Longitudinal data for behavioral research: The German Socio-economic Panel Study", University of Wisconsin, Madison, May 1988.

Ghez, G. and Becker, G. (1975), "The allocation of time and goods over the life cycle", NBER

Gomulka, J. and Stern, N. (1986), "The employment of married women in the UK: 1970-1983", Discussion Paper no 98, Suntory Toyota International Centre for Economics and Related Disciplines, London School of Economics and Political Science.

Gomulka, J. and Stern, N. (1990), "The employment of married women in the UK: 1970-1983", Economica, May, 57, pp.171-199.

Gonul, E. (1987), "Optimal Labor Force Participation Decision of Males", mimeo, NORC, University of Chicago.

Greenhalgh, C.A. (1977), "A labour supply function for married women in Great Britain", in Economica, vol.44, pp.249-265.

Greenhalgh, C.A. (1980), "Participation and hours of work for married women in Great Britain", in Oxford Economic Papers, 32, pp.296-318.

Grice, J.W. (1978), "A time series model for the labour supply", Treasury Working Paper AP (78) 11.

Gustafsson, S. (1992), "Separate taxation and married women's labour supply. A comparison of West Germany and Sweden", in Journal of Population Economics (5): pp.61-85.

Gustafsson, S. and Stafford, F. (1991), "Daycare subsidies and labor supply in Sweden", in Journal of Human Resources (in press).

Ham, J.C. (1986) "Testing whether Unemployment represents intertemporal labour supply behaviour", Review of Economic Studies, 53 (4), pp.559-578.

Hanefeld, U. (1984), "The German Socio-economic Panel", in American Statistical Association, 1984 proceedings of the Social Statistics Section, Washington D.C.

Hart, P.E. (1976), "The Dynamics of earnings, 1963-1973", in The Economic Journal, 86, September, pp.551-565.

Hartog, J., Ridder G., and Theeuwes, J. (eds.) (1990), "Panel data and labor market studies", Amsterdam, North-Holland.

Hausman, J.A. (1980) "The effect of wages taxes and fixed costs on women's labour supply", Journal of Public economics, 14, pp.161-194.

Hausman, J.A. (1981) "Labour Supply", in Aaron and Pechman (eds.) How taxes affect economic behaviour, pp.27-72, Washington D.C.: Brookings Institution.

Heckman, J.J. (1974), "Effects of child care programs on women's work effort" in Journal of Political Economy, 82, pp.136-163.

Heckman, J.J. (1976), "A life-cycle model of earnings, learning, and consumption", in Journal of Political Economy, vol.84, no.4, pt.2, pp.S11-S44.

Heckman, J.J. (1981), "Heterogeneity and state dependence" in Rosen, S (ed.), Studies in labor markets, NBER, University of Chicago Press, Chicago.

Heckman, J.J. and MaCurdy, T. (1980), "A life cycle model of female labor supply", Review of Economic studies 47, pp.47-74.

Heckman, J.J. and MaCurdy, T. (1982), "Corrigendum on a life cycle model of female labor supply", Review of Economics and statistics, 49, pp.659-660.

Hill, C.R. and Stafford, F.P. (1974), "Allocation of time to preschool children and educational opportunity", in Journal of Human Resources, 9, pp.323-341.

Holst, K., Strom, S., Wagenhals, G. and Ostervold, J. (1988), "Female labour Supply and Taxes in the Federal Republic of Germany in 1984", Paper presented to the working group on European Micro labour Markets, Heidelberg Meeting: 27-28 May 1988, Department of Economics, University of Oslo, memorandum no.5.

Hotz, V.J., Kydland, F.E. and Sedlacek, G.L. (1988), "Intertemporal preferences and labor supply", in Econometrica, vol.56, pp.335-360.

Hsiao, C. (1985), "Benefits and limitations of Panel Data", in Econometric Reviews, 4(1), pp.121-174.

Hsiao, C. (1986), "Analysis of Panel Data", Cambridge, Cambridge University Press.

Huier, R. and Schnabel, R. (1990), "The Estimation of Life-cycle models of labor supply using panel data", University of Frankfurt, Department of economics, Working Paper.

Hunt, A. (ed.) (1988), "Women and paid work: issues of equality", London, MacMillan.

Jakubson, G. (1988), "The sensitivity of labor supply parameters estimates to Unobserved Individual Effects: Fixed- and Random-Effects Estimates in a Nonlinear model using Panel data", Journal of Labor Economics, 6 (3), pp.302-329.

Jenson, J. Hagen, E. and Reddy, C. (eds.)(1988), "Feminization of the labor force. Paradoxes and promises", New York, Oxford University Press.

Johnson, T. and Pencavel, J. (1984), "Dynamic hours of work functions for husband, wives and single females" in Econometrica, 52, No.2 (March) pp.363-389.

Jonung, C. (1986), "Patterns of occupational segregation by sex in the labor market", in Schmid, G. and Weitzel, R. (eds.), (1986), pp.44-69.

Joshi, H. (1984), "Women's participation in paid work: further analysis of the Women and Employment Survey", Department of Employment Research Paper, no.45, London, HMSO.

Joshi, H. (1986), "Participation in paid work: evidence from the women and employment survey", in Blundell and Walker (eds.), Unemployment, Search and labour Supply, Cambridge, CUP, Ch.11, pp.217-242.

Joshi, H., Lavard, R. and Owen, S. (1985), "Why are more women working in Britain?", in Journal of Labor Economics, Vol.3, No.1, special issue, pp.147-176.

Joshi, H. and Owen, S. (1987), "How long is a piece of elastic? The measurement of female activity rates in British Censuses, 1951-1981", in Cambridge Journal of Economics, vol.11, No.1, pp.55-74.

Kaiser, H.; VanEssen, U. and Spahn, P.B. (1989), "Income taxation and the supply of labour in West Germany", Working Paper No.277-A, Jan. 1989, Universitat Frankfurt.

Kapteyn, A. and Woittiez, I. (1990), "Preference Interdependence and habit formation in family labour supply", in Florens, J.P. et al. (eds.) (1990) Ch.10, pp.231-264.

- Kendall, M. and Stuart, A. (1977), "The advanced theory of statistics", London, Griffin and Co. Ltd.
- Killingsworth, M.R. (1982), " Learning by doing and investment training a synthesis of two rival models of the life cycle" in Review of economic studies, 49, pp.263-271.
- Killingsworth, M.R. (1983), "Labor supply", Cambridge, Cambridge University Press.
- Killingsworth, M.R. and Heckman, J.J. (1986), "Female labor supply: a survey", in Ashenfelter, O. and Layard, R. (eds.), Vol.I, Ch.2, pp.103-204.
- Layard, R.; Barton, M.; and Zabalza, A. (1980), "Married women's participation and hours", in Economica, (47), pp.51-72.
- Leibowitz, A. (1975), "Education and the allocation of women's time", in Juster, F.T. (ed.), 'Education, income and human behavior'. New York, McGraw-Hill.
- Lilja, R. (1986), "Econometric analyses of family labour supply over the life cycle using US panel dat", The Helsinki School of Economics, Helsinki.
- Lillard, L. and Willis, R.J. (1978), "Dynamic aspects of earnings mobility", Econometrica, vol.46, no.5, pp.985-1012.
- Lundberg, S. (1985), "The added worker effect", in Journal of Labor Economics, Vol.3, No.1, pt.2, pp.S11-S37.
- MaCurdy, T.E. (1981), "An empirical model of labour supply in a life cycle setting", in Journal of Political Economy, n.89, pp.1059-1085.
- MaCurdy, T.E. (1990), "Appraising Tests of the Intertemporal Substitution Hypothesis", in Hartog, J., Ridder G., and Theeuwes, J. (eds.), pp.215-230.
- Main, B. (1988a), "The lifetime attachment of women to the labour market", in Hunt, A. (ed.), (1988), Ch.2, pp.23-51.
- Main, B. (1988b), "Women's earnings over the life-cycle", in Hunt, A. (ed.), (1988), Ch.5, pp.105-122.
- Mankiw, N.G., Rotemberg, J. and Summers, L.H. (1985), "Intertemporal substitution in macroeconomics", Quarterly Journal of Economics, Feb., pp. 225-251.
- Martin, J. (1986), "Returning to work after childbearing: evidence from the Women and Employment Survey", in Population Trends, n.43,

Spring, pp.23-30.

Martin, J. and Roberts, C. (1984a), "Women and Employment a lifetime perspective", London HMSO.

Martin, J. and Roberts, C. (1984b), "Women and Employment: technical report", London, Office of Population Censuses and Surveys/Department of Employment.

Martin, J. and Roberts, C. (1984c), "Women's Employment in the 1980s: evidence from the Women and employment survey", in Employment Gazette, UK. Dept. of Employment, May, pp.199-209.

McCabe, P. J. (1983), "Optimal Leisure-effort choice with endogenously determined earnings", in Journal of Labor Economics, vol.1, no.3, pp.308-329.

McNabb, R. (1977), "The labour force participation of married women", in Manchester School, 45, no.3, pp.221-235.

Merz, J. (1987), "Labor Force participation, market wage rate and working hours of married and unmarried women in the Federal Republic of Germany - the influence of occupational career, transfers and other socio-economic variables based on the German Socio-economic Panel", Working Paper No.249, Goethe - Universitat Frankfurt und Universitat Mannheim, August 1987.

Merz, J. (1990), "Female Labor Supply: Labor Force Participation, Market Wage Rate and Working hours of married and unmarried women in the Federal Republic of Germany", Jahrb. f. Nationalok. u. Stat. (G.Fischer Verlag, Stuttgart) Bd.(Vol.)207/3, pp.240-270.

Michael, R. T. (1973), "Education in Nonmarket Production", in Journal of Political Economy (18), pp.306-327.

Micklewright, J. (1990), "The analysis of pooled cross-sectional data. Early School Leaving", forthcoming in Davies, R. and Dale, A. (eds.), Social and Political Change a casebook of Methods.

Micklewright, J. and Giannelli, G. (1991), "Why do women married to unemployed men have low participation rates? Evidence from Panel data", European University Institute, Florence, Working Paper.

Mincer, J. (1974), "Schooling, Experience and Earnings", N.Y. NBER.

Mincer, J. (1985), "Intercountry Comparisons of Labor force trends and of related developments: an overview", in Journal of Labour Economics, vol.3, No.1, Special Issue, pp.2-32.

Mincer, J. and Polachek, S. (1974), "Family investments in Human capital: earnings of women", in Journal of Political Economy, 82,

March/Apr., pp.S76-S108.

Moffitt, R. (1984a), "The estimation of a joint wage-hours labor supply model", in *Journal of Labor Economics*, vol.2, no.4, pp.550-566.

Moffitt, R. (1984b), "Profiles of fertility, labour supply and wages of married women: a complete life-cycle model", in *Review of Economic Studies*, LI, pp.263-278.

Moffitt, R. (1988), "Estimating dynamic models with a time series of repeated cross-sections", Brown University, december, previous version of this paper presented at Summer meeting of Econometric Society, June 1988, Minneapolis.

Moffitt, R. (1991), "Identification and estimation of dynamic models with a time series of repeated cross sections", Brown University, April, paper presented also to 1990 World Congress of Econometric Society, Barcelona.

Moss, P. (1990), "I servizi per l'infanzia nella Comunita' Europea 1985-1990" in *Quaderni di Donne d'Europa*, n.31, Bruxelles, Commissione delle Comunita' Europee.

Mroz, T.A. (1987), "The sensitivity of an empirical model of married women's hours of work to economic and statistical assumptions", in *Econometrica*, 55, pp.765-800.

Nakamura, M. and Nakamura, A. (1985a), "Dynamic models of the labor force behavior of married women which can be estimated using limited amounts of past information", in *Journal of Econometrics*, 27, pp.273-298.

Nakamura, M. and Nakamura, A. (1985b), "The second paycheck: a socioeconomic analysis of Earnings", New York, Academic Press.

Nakamura, M. and Nakamura, A. (1989), "Children and female labor supply: a review of selected econometric issues", mimeo, Faculty of Business, University of Alberta, Canada.

Nakamura, M. and Nakamura, A. (1990), "The Econometrics of female labor supply and children", paper presented at the Econometric Society World Congress, Barcelona, August 1990.

OECD (1987), "Employment Outlook", Paris, OECD.

OECD (1988), "Employment Outlook", Paris, OECD.

OECD (1989), "Employment Outlook", Paris, OECD.

OECD (1990), "Economic Survey, Germany, 1989/90", Paris, OECD.

Office Population Censuses and Surveys (1984), "General Household Survey 1982", London, HMSO.

Pencavel, J. (1986), "Labor supply of men", in Ashenfelter, O. and Layard, R. (eds.), Vol.I, Ch.1, pp.3-102.

Ratner, R.S. (ed.) (1980), "Equal employment policy for women, Strategies for implementation in the United States, Canada and Western Europe," Philadelphia, Temple University Press.

Rendtel, U. (1989) "Vertrauensbildung und Teilnahmeentscheidung in Panelstudien - Über die Entwicklung der Antwortbereitschaft im Sozio-ökonomischen Panel" Sonderforschungsbereich 3 der J.W. Goethe-Universität Frankfurt und Universität Mannheim, Working Paper, No.313, Frankfurt.

Schmähl, W. (1983), "Income analysis based on Longitudinal data from Social Security records: the relative earnings-position (age-earnings profile) and individual replacement rate of German workers", in Atkinson, A.B. and Cowell, F.A. (eds.), 'Panel data on incomes', ST/ICERD, Occasional Paper 2.

Schmähl, W. (1985), "Prozessproduzierte Langschnittsinformationen zur Einkommensanalyse" Allgemeines Statistisches Archiv, vol.69, pp.275-285.

Schmid, G. (1986), "Women in the labour market and equal opportunity policy in Sweden, United Kingdom, United States and West Germany: Introduction", in Schmid, G. and Weitzel, R. (eds.), (1986), pp.1-19.

Schmid, G. and Weitzel, R. (eds.), (1986), "Sex discrimination and equal opportunity. The labour market and employment policy", WZB Publications, Gower House.

Schoer, K. (1987), "Part-time employment: Britain and West Germany", in Cambridge Journal of Economics, 11, pp.83-94.

Shaw, K.L. (1989), "Life - cycle labor supply with human capital accumulation" in International Economic Review, vol. 30, No.2, May, pp.431-456.

Smith, J.P. (1977), "Family labor supply over the life cycle", in Explorations in Economic Research, 4, pp. 205-276.

Snell, M.W., Glucklich, P. and Povall, M. (1981), "Equal Pay and Opportunities", Research Paper, No.20, Dept. of Employment, London. (published also in Labour Research, March, 1986)

Stewart, M.B. and Greenhalgh, C.A. (1984), "Work History patterns and the occupational attainment of women", in Economic Journal, 94, No.375, pp.493-519.

Strom, S. and Wagenhals, G. (1988), "Female Labour Supply in the Federal Republic of Germany", Working Paper, July 1988.

Thatcher, A.R. (1971), "Year-to-year variations in the Earnings of individuals", in Journal of Royal Statistical Society, series A, vol. 134, pp.374-382.

Theeuwes, J. and Woittiez, L. (1990), "A consumers' guide to the elasticity of labour supply", Leiden University, Faculty of Law, Department of Economics, Working Paper.

Vogel-Polsky, E. (1985), "National institutional and non-institutional machinery established in the Council of Europe member states to promote equality between women and men", Committee for equality between women and men, Strasbourg.

Vogelheim, E. (1988), "Women in a changing workplace. The case of the Federal Republic of Germany", in Jenson, J., Hagen, E and Reddy, C. (eds), Ch. 6.

Wales, T.J. (1978), "Labor supply and commuting time", in Journal of econometrics, 8, pp.215-226.

Weiss, Y. (1972), "On the optimal lifetime pattern of labor supply" in the Economic Journal, 82, Dec., pp.1293-1315.

Weiss, Y. (1986), "The determination of life cycle earnings: a survey", in Ashenfelter, O. and Layard, R. (eds) (1986), vol.1, Part 3, Ch.11.

Weiss, Y. and Gronau, R. (1981), "Expected Interruptions in labour force participation and sex-related differences in earnings growth", in Review of Economic Studies, 48, pp.607-619.

Willis, R.J. (1986), "Wage determinants: a survey and reinterpretation of human capital earnings functions", in Ashenfelter, O. and Layard, R. (eds) (1986), vol.1, Part 3, Ch.10.

Zabalza, A. and Izannatos, Z. (1985a), "Women and equal pay: The effects of legislation on female employment and wages in Britain", Cambridge, Cambridge University Press.

Zabalza, A. and Izannatos, Z. (1985b), "The effect of Britain's Antidiscriminatory legislation on relative pay and employment", in Economic Journal, 95, (Sept.), pp.679-699.

